This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

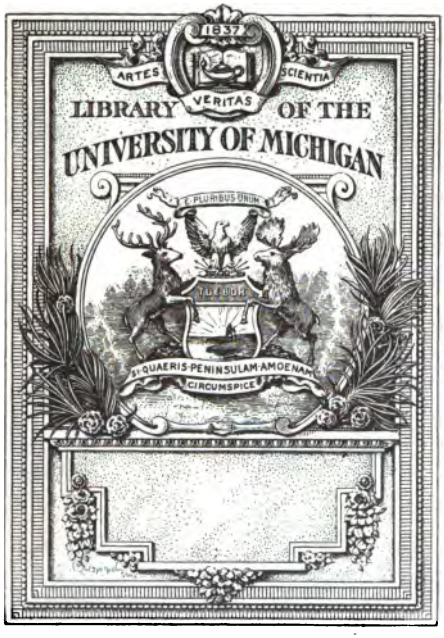
+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`


1837
ARTES
SCIENTIA
VERITAS
LIBRARY OF THE
UNIVERSITY OF MICHIGAN
E PLURIBUS UNUM
SI QUAERIS PENINSULAM AMOENAM
CIRCUMSPICE

TP
910
.S63

7851

THE

MANUAL OF COLOURS

AND

DYE WARES:

THEIR PROPERTIES, APPLICATIONS, VALUATION, IMPURITIES, AND SOPHISTICATIONS.

For the use of Dyers, Printers, Drysalters, Brokers, Etc.

BY J. W. SLATER,

AUTHOR OF "THE HANDBOOK OF CHEMICAL ANALYSIS FOR PRACTICAL MEN."

LONDON:

LOCKWOOD AND CO., 7, STATIONERS' HALL COURT.

1870.

[*The right of Translation reserved.*]

E. BENTLEY AND CO., PRINTERS, SHOE LANE, LONDON.

Q17 B206.5

PREFACE.

THE object of this Manual is to furnish, in brief space, an account of the chemical products and natural wares used in dyeing, printing, and the accessory arts—their properties, their applications, the means of ascertaining their respective values, and of detecting the impurities which may be present.

My experience has convinced me that information of this kind is needed, both by makers, dealers, and consumers, and I am not aware of any work which exactly meets the demand. The last seven or eight years have been very fruitful in novelties, and have witnessed such an enlargement of the resources of tinctorial art as to render older authorities defective, and in some measure obsolete.

It will be perceived that in the valuation of dye wares, I differ from certain authorities in relying more upon strictly chemical methods as distinguished from "rule-of-thumb" procedures. Without presuming to impugn the observations of others, I must say that having had prolonged opportunities of comparing the indications afforded by chemical tests with the valuations of experienced brokers and consumers, and again with the results obtained in actual use, I have found the first more reliable than the second. I believe that there are means of forging those outward features of colour, touch, taste, etc., upon which so many rely.

Rolls MW. 10-1-37

When the valuation of all dye wares can be conducted chemically, master dyers and chemists will be released from that strange bondage under which they now suffer.

It has been no part of my plan to give receipts, either for the manufacture of colours and mordants, or for their applications in dyeing and printing. Books exist which profess to give such information, but it is for the most part either inaccurate, incomplete, or, at best, rather out of date. In fact, such works seem to me to be placed in a dilemma. If their authors be mere *littérateurs*, or even men of abstract science, they *cannot furnish* all the required particulars. If they are practical men they *will not*. Few persons are so generous as to reveal to the world the best and newest processes in their possession,—processes which alone, perhaps, enable them to cope with wealthier competitors.

Concerning adulteration and other tricks of trade, little need be said, or rather, too much has been said already. Rife as sophistication and bribery doubtless are, the question arises, who is entitled to throw the first stone, or how the dreamed-of reforms are to commence. To be known, or even suspected, as the denouncer of such evils is to become a "black sheep," assailed by weapons as deadly and more dastardly than those of any saw-grinders' trades-union.

In conclusion I will merely add that, to the best of my belief, these pages contain a large amount of practical information never before printed, and which I venture to hope may prove useful.

It is necessary to make brief allusion to a new discovery which, if substantiated, promises to create a revolution in the tinctorial world. Messrs. Walker, of Mansell Street, London, whilst experimenting upon certain African plants as materials for paper-making, profess to have come upon certain dyes

which it is declared are equal to the coal-tar colours in purity and brilliance, and much superior in point of stability. The patentees assert that they can produce black, crimson, scarlet, and purple, in any shade, upon wool and silk, and good black upon cotton. The product is not yet in the market.

In opposition to the parties above-named, Mr. H. W. Barry, of Crutched-Friars, London, claims to be the original discoverer of the new colours, and states that Messrs. Walker were surreptitiously informed of his process by a person in his employ.

The apparatus and reagents mentioned in this work can be obtained from Mr. James How (successor to G. Knight and Sons), Foster Lane, Cheapside, E.C., from Messrs. Mottershead, Market Place, Manchester, or from other dealers in scientific requisites.

THE MANUAL OF COLOURS AND DYE WARES.

Acetate of Iron.—(*Black Liquor, Black Mordant, Pyrolignite of Iron.*)—This very important mordant consists of protoxide of iron, combined with and kept in solution by crude wood-vinegar, or pyroligneous acid. It is prepared by two distinct methods. Either scrap iron is dissolved in the free acid—generally with the aid of heat—or a solution of copperas is mixed with one of some soluble acetate, such as the acetates of lime, or lead. Contrary to what might be expected, pure acid or pure soluble acetates do not produce as good a quality of black liquor as that containing a certain amount of tarry matter. Concerning the part played by this tar in dyeing there is some diversity of opinion.

Black liquor is sold at different strengths, ranging from 10 to near 30° Tw. It has an astringent taste, is an olive colour, but in large quantities it appears black.

It serves for producing upon cotton a variety of shades according to its strength, and the colouring matter with which it is used. It gives its oxide of iron to the fibre more readily than copperas.

The per-acetate of iron—acetate or pyrolignite of the per-oxide—has been proposed as preferable to nitrate of iron, but has scarcely received any other than mere experimental applications.

To find if black liquor is genuine add a little nitric acid, and apply heat to per-oxidize the iron. Then add excess of ammonia, and filter off the precipitate. The clear liquid remaining is evaporated to dryness, and the residue heated strongly. Nothing should remain but a trace of carbon derived from tarry matter. If common salt has been added to raise the Twaddle it will be found as a white mass.

Acetic Acid.—(*Pyroligneous Acid, Acetous Acid, Wood Acid, Tar Acid, Wood Vinegar.*)—This acid for manufacturing purposes is prepared by submitting wood to destructive distillation, whence the name pyroligneous acid. For domestic uses it is in most countries obtained by the fermentation of sugar, treacle, or inferior kinds of wine. In England vinegar is made from malt, in conformity with an unhappy prejudice.

In a state of absolute purity it is a solid body at temperatures below 60° Fahr. It has a sour smell and taste; but does not redden litmus unless water is added. The ordinary liquid acid of commerce contains large and variable amounts of water. By a strange peculiarity the specific gravity or Twaddle affords no clue to its real strength, that is, to the per centage of dry or real acid present. An acid containing 79 to 80 per cent. marks strongest, whilst one containing 99, and one containing only 57 per cent. raise the Twaddle to the same point, viz., 13°. In consequence some other standard than specific gravity has to be employed in speaking of the strength of samples. Many manufacturers and dealers speak of acetic acid as being of one strength, two strengths, etc., up to seven. This is a remnant of the old excise system. It would be better simply to state the per centage of real acid any sample is warranted to contain. The ordinary range is from 14 to 24. It should be colourless, free from turbidity, have no oily or tarry scum on its surface; should leave behind no solid matter if evaporated to dryness. It should give no white precipitate if mixed with a little nitric acid and chloride of barium. If one is formed it indicates the presence of sulphuric acid. If muriatic acid is present it gives a white precipitate if a few drops of nitric acid and a little solution of the nitrate of silver are added. Acetate of lead in large quantity is a frequent impurity. If present, solid matter will remain on evaporation. If a few drops of sulphuric acid are added to the suspected sample, a heavy white precipitate will fall if lead is present. It will be observed that, except in exceedingly minute proportions, the presence of lead in a sample of acetic acid proves the absence of sulphuric acid. The presence or absence of mineral corrosive acids, such as the sulphuric and muriatic, may be ascertained by moistening a strip of white calico or linen with the suspected sample, and evaporating it to dryness at a gentle heat. If such acids are present the tissue will be tendered, or even blackened and corroded, according to the quantity of the impurities.

Acetic acid is used in dissolving certain aniline colours, in the preparation of aluminous and iron mordants, in the manufacture of soluble acetates, and in mixing certain colours for printing.

For estimating the strength of a sample of acetic acid, see ACIDIMETRY.

To detect *free* sulphuric acid, as distinguished from soluble sulphates, a portion may be mixed with a little starch and evaporated down to one-half its bulk. When cold, a drop of the tincture of iodine is added. A blue colour indicates the presence of free acid.

Acidimetry.—This process is the converse of alkalimetry. It signifies the estimation, by means of a standard alkaline solution, of the real saturating power of a commercial sample of any acid. For this purpose 270 grs. of the pure carbonate of soda, as prepared for standardizing the acid used in alkalimetry, are dissolved in 10,000 gr. measures of distilled water. 1000 gr. measures of this will saturate exactly 20 grs. of dry sulphuric, 18·5 grs. of dry hydrochloric, 27 grs. of dry nitric, 30 grs. of crystalline acetic, 22·5 grs. of dry oxalic (C_2O_3+HO), 57 grs. of dry tartaric, and 97 grs. of dry citric acids.

Fifty grains of the sample to be tested are next weighed into a suitable basin. This is done by means of a pipette if the acid is liquid. It is next diluted with water, or if a solid, dissolved in water, and the alkaline standard solution is dropped in with the pourette, till a drop of the liquid no longer reddens litmus paper. The amount of standard solution consumed shows the amount of real acid contained in the 50 grs. taken.

Acids.—A very numerous and important class of bodies. Some of them are solids, as the silicic and boracic; some liquid, as the sulphuric; and some gaseous, as the carbonic and sulphurous. A sour taste is not a necessary characteristic of an acid, belonging to such only as are soluble in water, whilst other bodies of indisputably acid properties are tasteless.

Many acids have, when applied in a concentrated state, a destructive effect upon ordinary organic matter. This is eminently the case with the three most common—the sulphuric, nitric, and muriatic, and to a less degree with certain organic acids, such as the oxalic. Others, such as the phosphoric, have no corrosive action.

The only property common to all acids is their power of combining with and neutralizing the so-called bases, such as soda, ammonia, oxide of zinc, aniline, etc. Those acids which are soluble in water give a red colour to blue litmus paper. This result is called the "acid reaction," and when it is produced by any liquid or mixture, is regarded as proof of the presence of some acid in a *free* or unneutralized state. As soon as the acid is exactly saturated or neutralized with its equivalent of a base it no longer produces this effect.

Many substances can play the part either of an acid or a base, according to circumstances; of this kind are alumina, oxide of lead, oxides of tin, etc.

Agar-agar.—A yellow sea-weed produced on the coasts of the Malay Archipelago. It resembles Iceland and Irish moss in its properties, and has been tried as a thickener for colours, and as a size for finishing; but with no very satisfactory results.

Ageing Liquor.—A compound, or rather mixture, of an alkaline arsenite with chlorate of potash, which some printers have employed to fix mordants, instead of submitting the pieces to the usual "ageing" process. By this means time is saved; but practical men complain that the action of the liquid is irregular, whilst to chemical theory its composition appears irrational.

Air.—To the dyer and printer the air is of interest as the medium in which all their operations have to be performed, and which must consequently influence the results. The hypothetical composition of the air needs but very brief mention. It is a mixture, not a compound, of 21 measures of oxygen to 79 of nitrogen. Besides these ingredients, it contains small variable quantities of carbonic acid, watery vapour, ammonia, ozone, sulphurous acid, muriatic acid, gaseous hydrocarbons, etc. Besides these gases and vapours, it holds in suspension the dust or minute particles of a variety of solid bodies, inorganic and organic, and especially the spores or germs of the lower forms of animal and vegetable life.

These minor ingredients, many of them imponderable, exert, nevertheless, a very important, and in some cases, a very pernicious influence upon dyed and printed fabrics. I mention some of the more destructive:

Sulphurous acid gas. A compound of sulphur with oxygen in proportion of 16 lbs. of the former to 16 lbs. of the latter. A colourless, invisible gas of the well-known suffocating odour of burning brimstone. It is readily soluble in water, and in contact with moist air and fibrous organic matter it takes up more oxygen, and passes by degrees into sulphuric acid, or oil of vitriol.

Sulphurous acid is given off whenever coal is burnt, from the iron pyrites present; further, whenever sulphurets of iron, copper, lead, etc., are roasted, and in a variety of other manufacturing operations. The quantity of sulphurous acid poured into the air from these sources, and left to exercise a destructive action, is enormous. The average of coal burnt in boiler-furnaces, etc., contains nearly 1 per cent. of sulphur; but if we assume merely 1 lb. per ton, we get results sufficiently alarming. A single manufacturing establishment, consuming 20 tons of coal daily, turns into the air 240 lbs. of sulphurous acid weekly, which is ultimately converted into 360 lbs. of oil of vitriol, or two ordinary sized carboys! What then must be the total amount from the entire quantity of coal consumed. Sulphurous acid has a tendency to destroy many colours, especially while in the moist state, and in air, highly charged therewith, they will, therefore, prove far less permanent than in a dry, pure atmosphere. As it passes into sulphuric acid the action is modified. It ceases to bleach, but, instead, it alters the tone of colours, and tenders the material, especially vegetable fibre. There is no definite prospect of a decrease in the amount of sulphurous acid in the air. Smoke-consumption, however perfect, will rather increase than lessen the evil. All that can be done is to obtain the utmost possible amount of duty from every pound of coal burnt, so that there may be no unnecessary consumption with its accompanying nuisance.

Sulphuretted hydrogen, sulphide of hydrogen, or hydrosulphuric acid, is a compound of sulphur and hydrogen, formed when organic bodies containing sulphur enter into putrefaction. It blackens all compounds of lead, both in the mass and on the fibre, and exerts a similar though less powerful action upon compounds of tin, copper, antimony, and mercury.

Muriatic acid gas and *chlorine* are now less abundantly met with in the air than before the act for the regulation of alkali-works came into operation. They are highly destructive, especially chlorine.

Alcohol.—(*Methylated Spirit, Finish.*)—Absolute alcohol, free from water, is a clear colourless liquid, highly mobile, volatile and combustible. Its specific gravity is 0·79, or in other words it weighs 7 lbs. 15 ozs. per gallon. It boils at 173° Fahr., and freezes about 167° below zero.

The ordinary "methylated spirit" of this country, weighs about 8 lbs. 1 oz. to the gallon, and consists of alcohol very strong, though not perfectly free from water, to which a small portion of wood-naphtha or methylic alcohol has been added. This addition is the condition upon which its sale duty free for manufacturing purposes is permitted.

Unless, however, the consumer can find heavy security that he will use the spirit for no other purpose than the one he has specified in his application to the revenue authorities, further additions are insisted on, and the mixture is called "finish." These additions, as far as the tinctorial arts are concerned, have been very unfortunately selected. Under the mistaken notion that the whole or most of the spirit would be consumed in varnish-making, government required that a certain quantity of shellac should be dissolved therein. Now shellac greatly reduces the solvent power of alcohol for the aniline colours, and when the mixture is put in the dye-beck, the colour is much more apt to be separated out. Besides, shellac causes the colours to work flatter, and gives the reds a blueish tone which is not always desired.

Another addition is to colour the spirit blue or red. Now whichever colour is selected, will, under certain circumstances, be objectionable. A blue solvent spirit will impair magentas, and a red solvent injures opal blues; either being, of course, fatal to greens.

It would, in my opinion, have been far more judicious, if instead of resinous or tinctorial matters, some substance highly offensive in taste and smell had been ordered as an addition.

The principal use of alcohol in dyeing and printing is to dissolve the coal-tar colours, for which purpose it should be very pure. The presence of aldehyde, fusel and empreumatic oils, has a bad effect. The alcohol when heated with 1 per cent of *pure* caustic potassa, should turn bright yellow. If it becomes brown it should be rejected.

Albumen.—An organic compound known as white of egg,

and occurring also in the serum of blood, and in other animal and vegetable juices and solids. It is soluble in water and if carefully dried at 120° Fahr. can be re-dissolved, but if heated to 158° to 160° Fahr., it becomes insoluble in water. In its ordinary state it is coagulated by alcohol, carbolic acid, acetate of lead, chloride of mercury, tannin, prussiate of potash, and all acids except the acetic and phosphoric. The precipitates formed with acids are soluble in pure water, but quite insoluble in diluted acids.

Albumen coagulated by means of heat, dissolves in strong muriatic acid with a purple colour. It dissolves also in caustic soda and ammonia, which it neutralizes. Liquid albumen is capable of dissolving phosphate of lime.

Albumen contains small quantities of sulphur and phosphorus, apparently in an unoxidized state.

It was first introduced as a mordant by Broquette (Mordants, Animal), and serves for fixing aniline and archil colours, etc., upon vegetable fibre. It is also employed for fixing pigment colours in printing. Alkaline bisulphites have the property of checking its tendency to putrefaction. With gum-water it is miscible to a certain extent.

Aldehyde.—A very volatile, colourless, mobile liquid, of a peculiar suffocating odour. It is prepared by the action of sulphuric acid upon a mixture of absolute alcohol and bichromate of potash.

It is a most powerful reducing agent, being able to withdraw oxygen from almost all bodies capable of yielding it.

Its principle use in the tinctorial arts at present, is in the preparation of the so-called "aldehyde green."

Alder bark.—The bark and even the wood of the common alder contain a colouring matter of the astringent tribe. When exposed to the air they rapidly take a deep brown shade. Hence "brown as a peeled owler," is a provincial proverb in some parts of England. With iron it gives upon silk a softer and bloomier black than can be obtained from galls, or any other astringent. It was sometimes used to give yellowish browns, with preparations of tin and alum, but has now fallen into disuse.

Algaroba.—An astringent matter resembling catechu in

its appearance and nature. It said to be derived from a tree of the same name, and is imported from the La Plata.

Alizarine.—The most important of the colouring principles contained in madder. It is the madder-red of Berzelius and Runge.

Alizarine sublimes in orange-coloured crystals on the surface of madder exposed in thin layers to a heat not sufficient to char it.

Alizarine is insoluble in cold, but slightly soluble in boiling water, with a yellow colour, and on cooling separates in yellow flocculent crystals. In hot alcohol it dissolves more freely. The spirituous solution gives purple precipitates with the acetates of iron and copper. In alkaline solutions, caustic and carbonated, alizarine dissolves with a fine violet colour, from which it is again thrown down by acids in dull reddish flocky masses.

It produces upon mordanted cloth colours identical with those dyed with madder.

By the aid of reducing agents, the other colouring matters present in madder may all be converted into alizarine.

The name alizarine is applied in commerce, not to the pure substance above described, but to a kind of extract, made by submitting MADDER-FLOWERS to high-pressure steam in a suitable apparatus. It dyes excellent purples, but is not well suited for the other madder shades.

Certain qualities of GARANCINE, specially prepared for purples, are also frequently sold under the name alizarine.

Alizarine, artificial.—This colour is artificially obtainable from paranaphthaline or anthracene—one of the products of coal-tar.

The artificial product appears not merely to be identical with the alizarine prepared from madder in its elementary composition and in its behaviour with chemical reagents, but yields upon mordanted cotton shades very similar if not identical.

It has not yet been introduced into commerce on a large scale. There is still, however, room for doubt, whether a body so complex as madder—most of whose constituents have a modifying effect in dyeing—can be entirely successfully replaced by any one principle.

Alkalimetry.—A rapid and convenient method for finding

the real value of soda ash, Canadian potashes, and other commercial alkaline matter.

For this purpose we require a standard pure dilute sulphuric acid, and to ascertain its value, a standard absolutely pure carbonate of soda.

The preparation of such standard carbonate of soda is somewhat tedious. Select the smallest well-defined crystals of commercial carbonate of soda, dissolve them in pure warm water, evaporate the solution down, and when it is near the crystallizing point, cool it rapidly by setting the beaker in a basin of cold water, and stir continually. The carbonate will then be deposited in the form of a fine crystalline meal. Pour away the mother-liquor, throw the powder upon a filter, and wash it with pure water till the washings—after being acidulated with pure nitric acid—no longer cause a precipitate either in a solution of nitrate of silver, or in one of chloride of barium. The mass is then placed in a basin of silver, platinum, or clean sheet iron. It is lightly covered over, evaporated to dryness, and then exposed for two or three hours to a high sand bath heat, not amounting to redness. It is then placed in a beaker, dissolved in pure water, and the deposit of silica, etc., is filtered off. The clear liquid is again evaporated to dryness, small fragments of pure carbonate of ammonia being added from time to time. It is once more dissolved in pure water, and should any flakes of silica appear they are filtered off. The liquid is then evaporated to dryness, in a platinum vessel, and exposed for three hours to a heat just bordering on dull redness. It is now cooled under a bell-jar over a dish of sulphuric acid (exsiccating or desiccating apparatus), and preserved for use in well-stoppered bottles.

Pure sulphuric acid is now diluted with about ten times its bulk of pure water, and allowed to cool.

Next weigh out exactly 50 grs. of the pure carbonate, place it in a porcelain basin capable of holding rather more than a pint, dissolve it in pure water, and set the basin over a gas-lamp or other manageable source of heat. Cut up some of the very palest neutral-grey litmus into very small bits, and lay them close at hand upon a white slab.

An alkalimeter or pourette,—by preference Mohr's—is next filled with the dilute acid and allowed to drop gradually into the alkaline solution, the heat being kept close upon boiling. From time to time a drop of the solution is taken out of the basin by

means of a fine glass stirring-rod, and applied to one of the bits of test-paper. The moment that this shows the very faintest tinge of real, permanent red, the acid liquor is no longer permitted to drop, and the number of degrees consumed is read off. This number is of course the quantity of the acid required to neutralize 29·2 grs. of actual soda, being the amount contained in 50 grs. of the pure carbonate. Supposing that 90 degrees of the alkalimeter have been consumed, then label the bottle of standard acid. "90 degrees of standard acid = 29·2 grs. actual soda." Should the number of degrees consumed exceed 95, the acid is too weak, and a little pure sulphuric acid must be added, well mixed up and allowed to cool. On the other hand if it fall short of 70, the standard acid is too strong, and must be diluted with a little pure water. In either case a fresh operation must be performed to ascertain the exact strength. The only difficulty in the process is to discriminate between the true red produced upon the litmus paper by a very slight excess of sulphuric acid, and the transitory purplish or claret-coloured stain caused by the liberated carbonic acid. A bit of litmus paper, on being touched with the drop of liquid will often, towards the end of the process, be fugitively reddened in this manner, but if the operator wait a little, he will see this redness disappear, and the paper resume a blue colour. It is scarcely needful to state that no vapours, either acid or ammoniacal must be present, or the result will be deceptive.

Some chemists instead of using bits of litmus paper to indicate the point of saturation, pour a little tincture of litmus into the basin. This tincture or solution is made by grinding half an ounce of litmus to powder, pouring upon it half a pint of pure water, and allowing it to stand for a few hours at a gentle heat. The clear is then poured off from the sediment, and preserved in a bottle stoppered loosely so as to allow access of air.

In testing any commercial sample of soda ash, it is merely needful to weigh out 50 grs., and proceed exactly as above, Suppose that 81 degrees of the pourette have been consumed, and that the standard acid has the strength indicated above, viz. 90 degrees equal to 29·2 grs. of actual soda, then 90 : 81 = 29·2 : 26·2, the amount of actual soda in 50 grs. The amount per cent is therefore, of course, 52·4.

Alkaloids.—(*Organic bases.*)—Under this name are grouped

a number of compound bodies, which in their behaviour greatly resemble the common alkalies, soda, or ammonia. They colour red litmus paper blue, they combine with, and neutralize acids, and form well crystallized salts. They are for the most part composed of the four organic elements or organogens: oxygen, hydrogen, carbon, and nitrogen; and contain a large proportion of the latter. Many of them exist in living vegetables, such as strychnia, morphia, quinia, etc. Others are formed artificially by submitting organic matter to destructive distillation. Of this class are aniline, toluidine, etc. Though in themselves colourless, they yield, when treated with oxidizing agents, a vast variety of splendidly coloured derivatives, many of which have already come into use as dyes.

Alkanet.—The root of *Anchusa tinctoria.* It contains a large amount of a red colouring matter, which has received the names alkanine and anchusine, and which is insoluble in water, though soluble in alcohol, and in the fatty and essential oils. Anchusine is generally prepared by first digesting the roots in water, pouring away the liquor, and digesting again in a solution of carbonate of potash. From the blue liquor thus obtained, anchusine is thrown down by the cautious addition of an acid. With the alcoholic tincture of the root, proto-chloride of tin gives a crimson lake; acetate of lead, a blue; and salts of iron, a deep violet. It is used by perfumers for colouring pomades and oils, but is very rarely employed in dyeing and printing.

The true oriental alkanet (alkennah or al-hennah) is obtained from a different plant, *Lawsonia inermis.*

Alloxan.—(*Erythric Acid of Brugnatelli; quite distinct from the erythric acid obtained from orchella weeds.*) Forms colourless transparent crystals, very soluble in water, of an offensive odour, reddens blue litmus, and stains the skin purple. It is a product of URIC ACID, and is used in some methods of preparing ROMAN PURPLE.

Alloxantine.—Colourless or yellowish crystals, which if exposed to the vapour of ammonia turn red, and acquire a greenish golden lustre. It is formed either directly from uric acid, or by the action of nascent hydrogen upon ALLOXAN. It is used in the preparation of Roman purple.

Aloes.—When aloes is submitted to the action of oxidizing agents, especially nitric acid, a series of compounds are obtained, which stand in a close relation to the aniline and phenole colours. Nitro-benzole is detected among the products. Several acids are formed, approximating more and more closely to the picric as the acid employed is stronger, and the action more prolonged.

A variety of red, purple, maroon, and brown shades, have been obtained upon silk and wool with these compounds, and it is highly probable that these might be much improved and extended. As in all probability they would be much more expensive than the aniline colours, experimentalists have not felt disposed for further research in this direction, and the aloes colours may be considered as abandoned.

Aloetic acid.—A colouring compound formed by the action of aloes upon nitric acid, at about 50° Tw. It has been proposed as a dye for silk and wool, upon which it yields violet colours, capable of considerable modification by means of mordants. It has not come into practical use. See ALOES and CHRYSAMMIC ACID.

Alum.—(*Double Sulphate of Alumina and Potash, Roman Alum, Roach Alum, or Rock Alum.*)—The composition and origin of common alum are too well known to require notice. Although the earliest known mordant, it is still in daily and extensive use.

The only impurity to which it is liable when purchased in the lump is iron, in the state of sulphate of protoxide diffused through the whole mass. This impurity is very readily detected. A mixture of the ferrocyanide and ferridcyanide of potassium may be added to the solution of a portion of the alum. An *immediate* blue precipitate shows the presence of iron. On longer standing, as *e. g.*, for an hour, this mixture will produce a blue precipitate even in pure alum. Tincture of galls, or a solution of tannin in any form will produce a black colour in the solution of alum, if iron be present.

Some alum exhibits a faint reddish or rusty colour. This arises from iron in the state of insoluble peroxide. Samples of this kind need not be condemned unless, when tested, they exhibit iron also in a soluble condition.

Alum bought ground may contain a variety of intentional im-

purities. Among these are water, over and above the water of crystallization, common salt, and sulphate of soda.

Potash alum contains 10 per cent. of alumina, 33 per cent. of sulphuric acid, and 45 per cent. of water, three-fourths of which are expelled at 140° Fahr. One part of alum, at 54° Fahr., dissolves in 13 parts of water, at 122° Fahr. in 2 parts, and at 189° Fahr. in 0·06 of a part.

Basic-alum is made by adding carbonate of potash, or of soda, to a solution of alum, as long as the precipitate formed is redissolved. The sulphuric acid being thus saturated, the compound deposits alumina on the fibre much more readily than ordinary alum.

Ammonia-alum differs from common alum by containing sulphate of ammonia, instead of sulphate of potash. It has a similar crystalline form and taste. It contains rather more alumina and sulphuric acid than potash-alum, and is slightly more soluble. It may be distinguished by adding to the solution a few drops of a solution of caustic-soda, and applying a gentle heat. Ammonia-alum will be at once known by the strong smell of ammonia which it then gives off. If it contains iron, this may be detected in the same manner as in potash-alum.

The uses of alum are too numerous, and at the same time, too well known to require specification. In most cases it is immaterial whether potash or ammonia-alum be used, but the latter is unfit for the preparation of alkaline pink mordant. If any iron is present this seriously interferes with its uses as a mordant in dyeing bright colours, and in the manufacture of pigments, such as carmine.

Muriate of Alumina.—(*Chloride of Aluminium.*)—If the hydrate of alumina be dissolved to saturation in muriatic acid, we obtain a very soluble and deliquescent salt, rarely if ever used by dyers and printers; but often employed in the scientific investigation of colouring matters.

Nitrate of Alumina.—When in the solid state, generally, forms a tenacious gummy mass, not easily obtained in a crystalline form. Very soluble, both in alcohol and water, and deliquescent. Its uses in dyeing and printing are exceedingly limited.

Alumina, Sulphate.—(Known also as *Patent Alum and Cake Alum.*)—Consists of sulphuric acid saturated with alumina. It shows no tendency to crystallize, but forms softish, semi-granular masses. It is abundantly and rapidly soluble in water. It contains more alumina than alum by one-third, and differs also in containing much less water, and no sulphate of potash or of ammonia. In spite, however, of these advantages, and of its easy solubility, it has not, as was hoped, succeeded in replacing alum in dyeing and printing. One reason of this is that common alum, save for certain impurities of easy detection, is a perfectly definite compound of fixed and unvarying composition, whilst in the sulphate of alumina not merely the amount of water, but, what is more serious, the relative proportions of alumina, and of sulphuric acid, are subject to vary—a variation which does not reveal itself in the appearance or outward properties of the sample, and can be discovered only by a formal quantitative analysis. Now, nothing can be more fatal to the dyer or colour-mixer than an unknown and undefined fluctuation in the quality of his materials. Another objection to patent alum is the absence of the sulphate of potash, which, though not a mordant, does undoubtedly modify the action of the alumina, producing effects which are in some cases desirable. A similar modification can, however, be readily brought about by using sulphate of soda in the dye beck along with the sulphate of alumina. But it is already used in dyeing to a great amount, which will certainly increase as manufacturers succeed in producing it of greater purity and more regular composition.

In preparing other salts of alumina by double decomposition, such as RED LIQUOR, its superiority to alum is beyond dispute.

The principal impurity to which it is liable is iron, for the detection of which see ALUM.

It contains 15 per cent. of alumina, 35 per cent. of sulphuric acid, and 48 per cent. of water.

Ammonia.—The liquid ammonia, or ammoniacal liquor of commerce, is a solution of dry ammoniacal gas in water, which is capable of absorbing or dissolving it to the extent of 670 times its own bulk, or nearly half its own weight, acquiring the peculiar odour, taste, and properties of the gas. During the absorption the water expands very much in bulk, and of course decreases in weight. The very strongest has the specific gravity 0·875, weighing only 8¾ lbs. per gallon.

The specific gravity of ammonia, affords a good insight into its value since all impurities or adulterations would make it heavier. The principal impurities to which it is liable are *lime*. This imparts a turbidity or milkiness to the ammonia, and by degrees forms a sediment at the bottom of the carboys.

Sulphur in the form of sulphide of ammonium.—To detect this, add a trace of a solution of the nitroprusside of sodium, when a slendid but fugitive violet colour will be developed, if sulphur be present.

Tarry matters.—To detect these, allow the ammonia to stand in an open capsule or saucer until the greater part of the ammoniacal gas has evaporated, when traces of tar may be detected by their smell.

Aniline.—(Sometimes present.) The sample turns transiently reddish when mixed with nitric acid.

The sources whence ammonia is obtained are various, such as stale urine, nitrogenous animal waste (such as horns, hoofs, riddlings of shoddy, etc.), but the greatest quantity is prepared from the so-called ammoniacal liquor of the gas-works. Of the latter there are two kinds. Either the raw liquor is at once submitted to distillation, or it is neutralized with sulphuric acid and the sulphate of ammonia thus obtained, after purification by recrystallization, is distilled with slaked lime. The latter method yields by far the better product. Of course, if perfectly pure, the properties of ammonia do not vary whatever its source, but it is rarely purified to such an extent. The ammonia obtained from stale urine is generally preferred by practical dyers, its effects being probably modified by some unexamined body present in minute traces.

Ammonia is used in the manufacture of the archil colours, in the preparation of cochineal paste for crimsons, in fixing murexide, in modifying the shades produced by many other colours; it serves also to cleanse goods for dyeing. Its action in this respect is not unobjectionable. Certain colours cannot be produced in as full perfection upon tissues scoured with ammonia as if soap had been employed.

Carboys of ammonia if left unstoppered in dye or print works, frequently occasion mischief, the ammoniacal gas escaping, acting either upon colour mixtures, or upon goods exposed to the fumes.

Table showing the Quantity of Ammoniacal Gas (NH_3) *in Aqueous Solutions of different Specific Gravities* (*Dalton*).

Specific Gravity.	Grains of Ammonia in 100 grains of the liquid.	Boiling Points.
·850	35·3	26
·860	32·6	38
·870	29·9	50
·880	27·3	62
·890	24·7	74
·900	22·2	86
·910	19·8	98
·920	17·4	110
·930	15·1	122
·940	12·8	134
·950	10·5	146
·960	8·3	158
·970	6·2	173
·980	4·1	187
·990	2·0	196

Aniline.—A volatile organic base, discovered by Unverdorben among the products of the decomposition of indigo, and afterwards detected by Runge in coal-tar. It was formerly known as *crystalline* and *cyanol*.

When pure it is a colourless, oily liquid, of specific gravity 4° Tw. It boils at 360° Fahr., but evaporates gradually at common temperatures. It is readily soluble in alcohol, wood-naphtha, ether, aldehyde, and the oils, both essential and fatty. In water it is sparingly soluble. Its presence is detected by adding the suspected body to a solution of chloride of lime in water, when a beautiful, though transient, violet-blue colour is produced.

With the acids, aniline yields a series of finely crystallized salts, from which it is expelled by potash and soda, and also by ammonia in the cold, though at higher temperatures this action is reversed.

The common "aniline oil" of commerce is of a yellowish colour, an offensive odour, and is highly combustible. It is a mixture of aniline, properly so-called, with variable quantities of TOLUIDINE and other bases.

Two varieties of aniline-oil occur in commerce, the *light* and the

heavy, or, as they are sometimes called, *kuphaniline* and *baraniline*. In the light aniline, properly speaking, predominates, whilst the heavy consists mainly of toluidine. These two kinds are mixed in suitable proportions for conversion into the various aniline colours.

The uses of aniline in dyeing and printing are indirect, as it serves for the manufacture of the well-known colours, magenta, etc.

Aniline Blacks.—A variety of processes for obtaining aniline blacks have been patented, and to some extent brought into use. In the majority of these, such as that of Lightfoot, the earliest kind known, the colour was not prepared in a separate state, but was formed on the fibre by means of a salt of aniline, and subsequent treatment with salts of copper, and some powerful oxidizing agent, such as chloric acid, chlorate of potash, red prussiate, etc. These aniline blacks in printing had a very damaging effect on the copper cylinders and the colour doctors.

The aniline black of Lucas, sometimes described as Petersen's, is a ready-made colour, sold as a black semi-fluid mass, which requires merely to be thickened with starch, printed, and slightly oxidized, to give the finest shades. In permanence and beauty it surpasses all other blacks, and is by no means expensive.

The aniline blacks, unlike the remaining aniline colours, are readily applicable to cotton, but appear to have no affinity for animal fibre.

Aniline Blues.—(*Regina Blue, Bleu de Lyons, etc.*)—The aniline blues form a very important group of colours. They vary, both in manufacture and in shade, some approaching to a violet, others being a full blue, and others verging upon a green. They are met with in commerce in the form of a coarse powder of a reddish, coppery lustre, insoluble in water, but soluble both in alcohol and in wood naphtha.

The aniline blues, unlike magenta, are fast colours, not sensibly affected by light, heat, moisture, or prolonged exposure to the air. By the additions of acids to the dye bath, these blues are deprived of any violet or reddish colouring matter by which they may be accompanied. This is another important distinction; since, if an acid be added to the aniline violets, the colour is injured.

The ordinary aniline blues dye wool and silk readily, but no generally satisfactory method has been discovered of working them upon cotton, especially upon the warps of mixed fabrics. Certain mordants are indeed known which attach the colour in this case to the cotton; but, at the same time, they modify or even deteriorate the blue upon the worsted weft, rendering it duller, and of a more purple cast. Hence the general practice with this class of goods is confined to dyeing the worsted with an aniline blue, and subsequently getting up the warp with prussiate of potash, and a peculiar kind of nitrate of iron. The result is of course very far from perfect. In printing, the aniline blues are successfully produced upon animalized cotton tissues.

Aniline Browns.—(*Havanna Brown, Bismark Brown.*)—This substance occurs in the form of a blackish powder, readily soluble in water. It has a strong affinity for animal fibre, upon which it dyes fast shades without the aid of a mordant. By the addition of small quantities of sulphuric, hydrochloric, or tartaric acid, the colour can be modified on the yellow side, and redder effects can be given with a little magenta or aniline crimson.

Another aniline brown of a redder shade is met with under the name "Napoleon brown." The shades it produces are less full and brilliant than those obtained with Bismark. The aniline browns are not as yet duly appreciated, and will prove eminently valuable when their capabilities are better explored.

Aniline Grey.—A colour prepared by the action of arsenic acid upon aniline, the proportions, and time of action, and circumstances, being different from those prescribed for the preparation of magenta. The colour is soluble in alcohol, to which 10 per cent. of sulphuric acid has been added, and dyes good and permanent grey shades.

Aniline Greens.—Of all the coal-tar colours, the greens may hitherto be safely pronounced the least satisfactory. When well-made and well-applied, they certainly give shades of remarkable beauty, which have the great advantage of preserving their tone by gas-light. But their price is excessive, without being compensated by that prodigious tinctorial power which characterizes other aniline colours. They are further usually sent out neither as solids nor liquids, but as pastes of ever-varying consistence.

Now of all possible states a paste is the most objectionable, since some portions are always moister, and in consequence always weaker than others. If these pastes are suffered to dry up, their solubility and their tinctorial power are very much impaired.

Aniline greens are substantive colours upon wool and silk, but appear to greater advantage if assisted by a mordant. Cotton to be dyed with aniline green, is usually prepared with nut-galls and a per-salt of tin, or sometimes the double muriate. Acids turn all the aniline greens more of a yellow shade. Picric acid is especially recommended for the purpose, but has the serious disadvantage of impairing the lustre of the colour.

Some of the aniline greens dissolve in cold water without any sediment or residue. Others require the use of methylated spirit, or of an acid. It is to be noted that the makers themselves do not always give correct instructions how to dissolve their wares. I know an instance of a green, which was brought into discredit, because the manufacturer directed it to be boiled in methylated spirit. When too late, he found that cold spirit was the proper solvent. The best of these colours is undoubtedly the "Triple Pomona paste." This dissolves freely and rapidly in water, and dyes brilliant and solid shades. It is worked upon wool by the following process: A bath of warm water is made up at 158° Fahr., to which silicate of potash is added, sufficient to give the water a greasy feel. The wool, etc., is worked in this till saturated. The colour paste which has been separately dissolved in some cold water, is very gradually added to the above bath, working the wool, till a bit taken out and passed through some water acidulated with acetic acid, shows the shade required. The whole is then taken out and put in a separate bath of water, at 158° Fahr., soured with acetic acid. A little commercial tannin, or extract of galls, is added to fasten the colour. If needful, picric acid is added to this last bath for the yellower shades, the heat being kept at 158° Fahr. Finally it is washed in cold water.

The so-called *iodine green* is a residue of the manufacture of Hoffmann's violet.

The *aldehyde greens* are obtained by dissolving magenta in dilute sulphuric acid, and heating the mixture with pure aldehyde.

Viridine is produced from a mixture of rosolic and benzoic acids with aniline.

Aniline Red.—Called also by some makers "ruby" and "aniline crimson."

This is a red colour much inferior in beauty and purity to magenta, and sold at a much lower price. It is soluble either in alcohol or in boiling water, after having been previously treated with a small quantity of muriatic acid. To correct the acidity arising from this latter cause, a small quantity of ammonia is added to the dye-bath.

Aniline red will not dye a crimson equal to those obtained from cochineal. It is suitable for compound colours, such as maroons, clarets, and reddish browns, in which it supersedes peachwood, giving a brighter colour with less trouble, and at a less price. The colours thus obtained are, however, easily damaged.

Upon wool in all its forms, and upon silk, aniline red is a substantive colour. Upon cotton it requires to be fixed by a mordant, generally a per-salt of tin, such as "solution," or red cotton spirits, and an astringent.

Aniline Violets.—Under this head we include a very formidable list of colours sold under various names, some of them misleading and inappropriate. Thus we have mauve, harmaline, dahlia, primula, Mexican violet, etc., etc.

The aniline violets may be divided into two classes; the first comprises such as are insoluble in water, and have very little or no affinity for cotton.

The second class, including Hoffman's violets, Britannia violet, the primulas, etc., are soluble to a very considerable extent in water, although methylated spirit has to be employed when a very concentrated solution is needed. They will also work upon cotton even without a mordant.

In examining any aniline violet the first point is to ascertain whether it is homogeneous or consisting of a mixture of shades. Such mixtures may arise either from negligence in purifying the colour, or may be made purposely as a cheaper way of producing some shade.

To ascertain this, a particle of the colour is dissolved in methylated spirit, the solution is diluted with water, and a drop is placed upon a piece of white blotting-paper. If the colour be homogeneous, the spot produced will be perfectly uniform in shade; but if it be a mixture, it will consist of concentric rings of different shades.

Or the successive effects of different solvents may be tried upon the sample. Thus a common violet was suspected of being a mixture. It was boiled in pure water, and the liquid decanted off. This was of a bright red colour, and dyed a bit of worsted a common magenta. The matter undissolved by the water was next examined, by boiling in methylated spirit. It dissolved with a blue colour and dyed worsted a blue shade. Thus the sample was found to be a mixture of magenta and of an aniline blue. If dissolved entirely it certainly gave a violet. But such mixed colours are open to a very serious objection: the several parts of which they consist are never exactly alike in solubility, diffusibility, and affinity for the fibre, and in consequence the work done is not all alike.

Aniline violets are turned more to a blue by the action of acids. At the same time they are rendered duller, and their affinity for the fibre is decreased, especially as regards cotton. The insoluble violets bear acids rather better than the soluble kind. They are, as a whole, more permanent than magenta, but less than the aniline blues.

Annatto, Anotta, Annotta, Arnotto, or Rocou.—A pulp or paste prepared from the seeds of *Bixa orellana*, a shrub native in central South America, and cultivated at Cayenne, in the Antilles, and in India. It is found in commerce in different states, under the names of cake annatto, and of roll or flag annatto. The former is obtained principally from Cayenne. It is of a bright yellow colour, and rather soft to the touch. Roll annatto comes from Brazil, and is dry and hard, brownish outwardly and red within. It is commonly prepared by grinding the seeds, fermenting them with water, straining through sieves, and boiling down to the consistence desired. Other makers merely dissolve off the colouring matter from the seeds—on the outside of which it is chiefly if not entirely deposited—with hot water, precipitate the colour from this solution by the addition of an acid, and allow it to dry. In this state it is sometimes sold as bixine, a name which properly belongs to the pure colouring matter.

Annatto is frequently adulterated with ochre, and red-lead—frauds which may be readily detected by burning a portion to ashes. The statement that it is sophisticated with turmeric, appears to the author incredible, as to incorporate the two would be a tedious and therefore expensive process.

Annatto is readily soluble in caustic and carbonated alkalies, in borax, and in soap-lyes, forming orange-coloured liquids, in which acids form orange precipitates. With alumina it gives an orange-coloured, and with salts of tin a lemon-yellow, lake. It is one of the colours which can be worked upon woollens and silks, from alkaline solutions. Aluminate of soda or of potash is a good mordant. It contains two colouring matters, *bixine* and *orelline*; the former a yellow, and the latter a red. These two bodies are closely related, and appear under certain circumstances to be mutually convertible.

Annatto is used for bright yellows upon silk; and for nankeens and buff shades upon cotton, though to a less extent than formerly.

Antimony.—A brittle metal, having a considerable analogy to tin. Like tin, it forms an insoluble compound when acted on by strong nitric acid. Its acid solutions are also rendered turbid and precipitated if mixed with an excess of water, which, however, may be prevented by the addition of tartaric acid.

The oxides and subsalts of antimony, like those of bismuth, have a greater affinity for colouring matters, than for either animal or vegetable fibre.

Preparations of antimony rank among the reagents used in the preparation of coal-tar colours. Antimony-orange, a sulphuret of antimony, was formerly used to some extent in printing, but is now very little employed. Certain salts of antimony have been tried both as mordants for grain colours upon wool, and in printing as a preparation for steam-colours. The results are not satisfactory.

Aqua-regia.—The old name given to mixtures, in whatever proportion of nitric and muriatic acids. In modern works these mixtures are called nitro-muriatic, or nitro-hydrochloric acid. They differ greatly in composition, from two parts of nitric to one of muriatic, up to one part of nitric to seven of muriatic. The initial strength of each acid, and the presence or absence of water, help to modify the result. The larger the proportion of nitric acid, and the smaller that of muriatic acid and of water, the more rapid and violent will be the action.

In the tinctorial arts, aqua-regias are chiefly used in the preparation of tin spirits.

Archil or Orchil.—A colouring matter prepared from certain lichens—the so-called orchella-weeds—by the joint action of ammonia and of the air. It possesses little permanence. The feeblest acids turn it to a reddish purple, whilst alkalies in very minute proportions turn it a more blue shade. By exposure to air and light, it is in course of time totally destroyed. There are two principal shades of this colour—the blue, which makes its appearance at an earlier stage of the manufacture, and at which by proper treatment the change can be arrested; and the so-called red, which appears when the action of the air and ammonia has been allowed to proceed to a greater length.

Archil is brought into the market in two forms, as paste and as liquor. The former is prepared directly from the weeds, whilst the latter is manufactured from a strong aqueous decoction, which is then acted upon by ammonia and air. It is a finer and more delicate colour than the paste, and is used to the exclusion of the latter in dyeing slubbings which could not be cleansed from the fragments of the weed. Archil has a great affinity for wool and silk, but not for cotton, upon which it can only be worked by the aid of animal mordants. Astringents either alone or associated with mineral mordants, fail to draw it upon cotton to a satisfactory extent. Its uses are still extensive and varied, though for purples, violets, peaches, etc., it has to a great degree been superseded by the aniline colours. It is rarely used alone, but in many compound colours it is an important ingredient.

In quality archils differ greatly, both from variety in the weed employed, from the degree of care used in their manufacture, and from the presence or absence of impurities.

It may be too wet, containing merely 20 per cent. or under of solid matter, in which case an extra quantity is required to produce the required shades. The amount of moisture is readily found by weighing out a known quantity, drying at the heat of boiling water until no further loss is experienced, and then weighing the residue.

Archil may also be supersaturated with ammonia, in which case its affinity for the fibre will be feeble. If a cask of archil on opening gives off a pungent ammoniacal smell, it may be pronounced faulty in this respect. Time and exposure to air will remedy the evil.

Dyers often judge the quality of an archil paste by rubbing a portion upon the back of the hand, and allowing it to dry. If the

colour be well-made, a stain will remain upon the skin, which rubbing with a cloth or washing in cold water will not very readily remove. If the colour be bad, every trace of it can be quickly rinsed off with cold water.

It is sometimes fraudulently mixed with the extracts of logwood, sapan, or peachwood. To detect these, about 50 grs. of the suspected sample are mixed with 3 ozs. of water, and 50 drops of a solution of protochloride of tin, made by dissolving tin crystals in twice their weight of water, and boiled. If the archil be pure, a yellowish colour alone remains. If logwood liquor be present to the extent of 3 or 4 per cent., a greyish blue remains; and if any red wood has been used as an adulterant, the colour will be reddish.

Archil liquors range in strength from 8° to 16°, or even to 20°, Twaddle. The only way to ascertain whether this strength be real, or merely produced by worthless matter added to raise the hydrometer, is to dye a standard weight of woollen yarn, etc., with a known measure of the liquor, and compare the intensity of the shade produced with that yielded by other samples.

Argentine Effects.—A name given to the films of reduced lead or other metal deposited upon printed goods. (See BRONZES.)

Argol.—The juice of grapes contains a large quantity of tartaric acid in combination with potash. During the process of fermentation, a portion of this is eliminated and deposited as a crystalline crust or layer upon the sides of the vats. It is an acid salt, containing two equivalents of tartaric acid in combination with one of potash. It is very sparingly soluble in water.

Argols differ very much according to the kind of grape from which they have been obtained, as well as the subsequent treatment they have undergone. The deposit from red wines, little if at all refined, is sold as red argol, and serves for certain dark colours. For argols of a superior quality, so-called "white argols," the deposit, preferably from white wines, is dissolved in boiling water, skimmed, strained, and allowed to crystallize. By this process, which is sometimes repeated more than once, the argol is freed from seeds and skins of grapes, colouring matter, and lees, and assumes a very pale grey colour. Good argol is generally found in flattish pieces, having on one side a crystalline face, and on the other showing the grain of the wooden vessels in which it has

been crystallized. When broken it should exhibit a bright crystalline fracture; and when shaken in the hands or thrown down, should ring like fragments of earthenware. It should melt slowly in the mouth, with a pleasant taste of tartaric acid. The less dust and foreign matters the better.

When ground to a fine powder it should have a white colour, with a very faint pinkish grey tint. If this powder is stirred up in distilled water, and pure nitric acid added, there should be no effervescence, or escape of gas. If such be observed, carbonates, earthy or alkaline, are present.

The above mixture—that is to say, argol, nitric acid, and water,—is then heated till everything soluble is dissolved. The residue, which will consist of organic matter and sand, is then filtered off, washed with pure water, dried, and weighed. It should not exceed 1 or 2 per cent., though in some adulterated samples it may amount to 15 per cent.

The clear solution of argol in nitric acid and water, as filtered off from the sediment, is next divided into several portions and tested. To one portion add a solution of nitrate of baryta, or of chloride of barium. In good argols there may appear, after standing some time, a very slight white turbidity, from a trace of sulphate of potash present in the juice of the grape. But if the turbidity appears at once, and is of large amount, sulphuric acid is present in some impurity, and probably either as alum, or sulphate of soda.

To another portion of the solution add a few drops of a solution of nitrate of silver. If a white curdy precipitate is formed, some chloride—probably common salt—is present as an adulteration.

To a third portion add ammonia, and then a solution of oxalate of ammonia. If a white precipitate is formed on stirring and standing for a few minutes, lime is present. Here the same distinction must be made as in case of sulphuric acid. If the precipitate be very slight, it will be due to a trace of tartrate of lime naturally present; but if it be copious, compounds of lime must have been added.

The favourite adulteration in white argols is at present the lees or dregs of white wines, which, when dried up, form small, reddish grey lumps, much tougher than argol, without crystalline texture, and having a taste more vinous and less acid than the genuine article.

Red argols are generally obtained from red wines, or, if from

white, they undergo no purification. They are rarely intentionally sophisticated, but, as a matter of course, contain a much larger amount of organic refuse than the white sorts.

The use of argols in the tinctorial arts is extensive. Not only are they the source from which TARTARIC ACID and TARTAR (grey and white) are obtained, but they are also largely consumed in dyeing in a direct manner. The white qualities are used in dyeing scarlets, crimsons, and other cochineal colours, upon wool and worsted, as well as a variety of other colours. Red argols are used for darker shades, and, in particular, for certain tones of black.

Arsenic.—A hardish, very brittle metal, of a greyish white colour. It volatilizes at a red heat without melting. If heated with free access of air, it burns with a pale blue flame, emitting an odour somewhat like garlic, and is converted into arsenious acid. It is one of the lighter metals, its specific gravity being only 5·7. It has a strong analogy with phosphorus on the one hand, and with antimony on the other.

In the metallic state it is not applied to any use in the tinctorial arts, but several of its compounds are extensively employed.

Arsenic Acid.—A compound of arsenic containing more oxygen than arsenious acid. This is a glassy, colourless, transparent body, which absorbs water from the air, and dissolves in 6 times its weight of cold, and in 2 parts of hot water. It is a much more powerful acid than the arsenious, and forms more permanent compounds.

Arsenic acid is now very extensively used for the conversion of aniline into magenta. Of the arseniates, or compounds of arsenic acid with alkalies, and other bases, the most important is the arseniate of soda. This salt is very extensively applied as a dung substitute, and also in producing copper greens.

The use of arsenical compounds in the tinctorial arts certainly requires great caution. None of them, however, is more formidable than bichrome, the dangerous properties of which are much less frequently commented upon.

Arsenious Acid.—(*White Arsenic.*)—A white, heavy, solid body, occurring as a crystalline powder, and as heavy lumps. It is volatile at elevated temperatures. It dissolves in about 10

parts of hot, and 30 parts of cold water. In muriatic acid it is much more abundantly soluble. It combines with alkalies, playing the part of a very feeble acid, and forming salts called arsenites.

The arsenious acid of commerce is frequently adulterated with chalk, gypsum, heavy spar, etc. The best method of detecting these impurities is to heat a weighed portion to about 400° Fahr., in a crucible, when all the arsenious acid will evaporate away, and the impurities will be left behind. This operation should be performed either in the open air, or under a chimney which draws well, as the fumes of arsenious acid are exceedingly poisonous.

The principal of the arsenites is that of soda, which is used in certain dung substitutes, and in dyeing greens upon cotton with a salt of copper.

Artichoke Green.—A green dye has been proposed to be obtained by bruising artichokes and thistles, mixing with water, and agitating with ammonia. The process is not in use, the results being unsatisfactory. It is sometimes called "Verdeil's green."

Astringents.—A numerous and important class of vegetable substances, indispensable in cotton dyeing; the first operation of which generally consists in saturating the cloth or yarn with the extract or solution of some one of these bodies. They include DIVI-DIVI, GALLS, SUMAC, CATECHU, CUTCH or GAMBIER, MYROBALANS, VALONIA CUPS, POMEGRANATE HUSKS, HEMLOCK BARK, BABOOL or BABLAH'KINO, and many others of less importance. The value of all these depends on the presence of one constituent, tannin or tannic acid, which exists in them all, though in very different proportions and states, and modified by the presence of other substances.

As a general rule, any vegetable substance is an astringent, whose infusion strikes a dark-blue or black colour with copperas, and forms a coagulum or clot with glue.

Azale.—A preparation of madder. It is obtained by extracting MADDER-FLOWERS (*fleur de garance*) with wood naphtha at a boiling temperature. The clear liquid, filtered off from the insoluble matter, deposits azale in the form of a very copious yellow precipitate, upon being largely diluted with water.

Azuline.—A blue colouring matter, produced by the action of a high temperature upon a mixture of aniline and rosolic acid. After purification it appears as a reddish mass with golden reflections. It produces upon silk and wool shades similar to those obtained from the aniline blues.

Azurine.—An aniline blue colour of a very deep shade, approaching to indigo. It must not be confounded with azuline, which is different in shade, and prepared by a totally different process. It was produced upon the fibre, by a modification of the process for aniline greens patented in 1860 by Calvert and Lowe.

Barberry.—(*Berberis.*)—The alcoholic extract of the root of this shrub, gives a fine crimson with chlorine. It is not in use.

Barilla.—A word now only met with in old receipts. It was a crude kind of soda-ash, prepared by burning to ashes the sea-weeds of the Mediterranean coasts. It is now superseded by the artificial soda-ash prepared by the decomposition of common salt, a very much smaller quantity of which, being far stronger, will supply its place.

Barwood.—One of the hard class of red woods, of which it may be considered the type. It is obtained from the western coast of Africa, especially from Angola and Sierra Leone.

The wood in the log is compact, and when polished shows an orange-red colour. When rasped—the state in which it is generally sold—it is a rough, harsh powder, without smell, and of a red colour.

Its colouring matter amounts to 23 per cent., and is considered identical with santaline—the tinctorial principle of sanderswood. It is almost insoluble in water, and hence all attempts to prepare from it a liquor or extract, capable of being used in dyeing and printing, have failed. Boiling water takes up about 7 per cent. of colour, which on cooling is chiefly re-deposited as a reddish powder. Cold water, even after long maceration, takes up a mere fractional trace of the colour. In alcohol the colour of barwood is more soluble, but it is only by repeated treatment with boiling spirit that the wood can be entirely exhausted. In caustic soda and ammonia it dissolves with a purple-red colour, being re-deposited as a red powder on neutralizing the liquid with an acid.

An attempt has been made to take advantage of the solvent power of alkalies, for the purpose of obtaining an extract; but the brightness and permanence of the colour are found to be impaired, so that the process is not of practical value. Acetic acid extracts the colour becoming of a dark brown red hue, but this liquid when mixed with water dyes flat and meagre shades.

The alcoholic extract forms lakes or precipitates with the following reagents: proto-salts of iron, violet; salts of copper, brownish violet; sugar of lead, deep violet; chloride of tin, light red; sulphate of zinc, bright red; tartrate of antimony and potash, cherry red.

Its chief use is in dyeing upon cotton hanks the so-called barwood red, a shade much more permanent than any obtained from the soft red-woods, and used as an imitation of Turkey red. This process possesses two interesting peculiarities: absolute contact between the ware and the mordanted yarns appears necessary; and in the next place, unlike ordinary cotton-dyeing operations, it is carried on at a boiling heat. It is difficult to obtain the colour in perfection.

Extract of Bark.—(*Bark Liquor.*)—A liquid, containing or professing to contain the colouring matter of quercitron bark in a state of purity free from woody fibre. It is generally sold at from 8° to 10° Tw., which is a misfortune, as this strength is gained either by the addition of salt, etc., or by evaporation. Each of these methods is objectionable; the salt preventing the regular deposition of the colour upon the fibre, whilst by evaporation much of the colouring matter is volatilized and wasted. The colour most readily extracted is the finest. Some makers give the bark a final boiling up, with the addition of a little soda. This extracts a dull brownish colour, thus increasing the quantity of the product at the expense of its quality.

A solid extract, or rather lake, is also found in commerce.

Barwood Spirits.—A solution of tin in a mixture of nitric and muriatic acids, greatly resembling "red cotton spirits," or "solution of tin." The metal present is mainly in the state of a perchloride. As a general rule, barwood spirits contain less tin and nitric acid, and a larger proportion of hydrochloric acid, than "red cotton spirits." Its specific gravity is generally 33° to 36° Tw.

Baryta, Sulphate.—Called also *heavy-spar*, and sulphate of barytes. A heavy white insoluble body, found chiefly in Derbyshire, and used for weighting calico. It is a compound of baryta and sulphuric acid, and is unaffected by any reagent with which it is liable to come in contact.

The *carbonate of baryta*, known as *Witherite*, is sometimes used for the same purpose. It agrees in most of its properties with heavy-spar, but is attacked and dissolved by acids. Neither of them attracts moisture from the atmosphere.

Bases.—A class of bodies capable of combining with and neutralizing the acids. When soluble in water, they turn reddened litmus paper a blue colour, thus reversing the action of the acids. This is called the basic reaction, or sometimes the alkaline, because exhibited most strikingly by the alkalies, potash, soda, and ammonia. It must not be imagined—as the language of the older chemical works would lead the reader to believe—that all blue colours are reddened by acids, or all reds blued by bases. Indigo is not at all reddened by acids; carthamine is not blued by alkalies; with the aniline colours the action is indeed reversed, acids, as a rule, turning them more to a blue, and alkalies to a red.

Most of the bases are compounds of a metal with oxygen, but ammonia and the so-called organic bases or alkaloids contain nothing of a metallic nature, and yet are capable of neutralizing acids and forming regular and stable salts.

Benzoic Acid.—A peculiar vegetable principle, of feebly acid properties, existing in gum benzoine. When pure it forms exceedingly light and soft white scales, of a sweetish-acrid taste, soluble in 25 parts of hot, and about 200 of cold water. At a strong heat it is entirely volatilized, and is re-deposited on any cold surface.

Its uses in the tinctorial arts are very limited. It serves to modify the shade of the product in the manufacture of aniline violets.

Benzole or Benzine.—Pure benzole is a clear colourless liquid of a peculiar penetrating odour, and the specific gravity, 0·85, being considerably lighter than water. It boils at 186° Fahr., freezes at 32° Fahr., forming a waxy mass. It is insoluble

in water, either boiling or cold, but dissolves in alcohol and ether.

Benzole has not only become of great commercial importance as the starting point for the preparation of aniline and its numerous coloured products, but it has its direct uses in dye-works. It is, namely, one of the most efficient solvents known for grease and fatty matters, resins, etc. Consequently, if goods during the processes of dyeing and finishing become spotted with oil or any similar body, benzole is generally selected to remove the blemish —which it effects without injuring even the most delicate colours.

Bismuth.—A very ponderous metal of a pinkish grey colour, and very brittle. Its uses at present are almost exclusively confined to the making of certain alloys and solders, but its analogy with tin has led to many experimental attempts to employ it as a mordant. Its affinity for colouring matters is great, and a variety of beautiful lakes may, with due precautions, be prepared from it. Its affinity for the fibre is, however, feebler than that of tin; it is considerably dearer, and its acid solutions, when diluted with water, are decomposed, the bulk of the bismuth being thrown down in the state of an insoluble sub-salt. This evil may, indeed, to some extent be counteracted by the addition of an excess of acetic acid; but even then the shades produced, though rich and brilliant, are deficient in evenness and solidity.

The writer is, nevertheless, of opinion, that it may yet be made to yield desirable results, if carefully studied.

Bisulphide of Carbon.—This preparation is coming into extended use for the purpose of freeing wool from its grease, for which it has remarkable solvent powers.

It is a transparent and colourless fluid, which refracts light strongly, is highly mobile, and evaporates with great rapidity on exposure to the air, even at common temperatures. It has an unpleasant odour, is highly inflammable, and will not mix with water.

It is an excellent solvent for the oils and fats, resins, etc.

When used for cleansing wool, it offers great advantages. The fibre is not in the least weakened or roughened; the grease can be collected without trouble, and the same quantity of bisulphide of carbon can, with proper management, be used again and again.

Black Ash.—(*Crude Soda, Ball Soda.*)—This is the first crude result of the decomposition of salt-cake, containing, besides caustic and carbonated soda, lime, oxide of iron, carbon, etc. It was at one time employed by bleachers to a large extent, but is now abandoned. It forms large blocks of a dark colour, and is very readily soluble, leaving, however, a quantity of insoluble impurities.

Black Mordant.—A mixture of bichromate of potash with refuse saline matter, and with some bone-black of low quality. This strange composition was then ground to a fine powder. About the time when the use of bichrome in conjunction with logwood for dyeing black was discovered, this "black mordant" was put into sale as something preferable, and many practical dyers seriously believed, or, at any rate, asserted, that they could obtain with it better results than with the best quality of genuine bichrome.

It has now, I believe, quite disappeared from the market.

Black Colours, Detection of.—*Chrome Blacks.*—Turn a chesnut brown with chlorine gas or bleaching-powder. Acquire a greenish shade on exposure to bright sunshine.

Logwood blacks with copperas.—Hydrochloric acid a cherry red. Bleaching powder discharges them, leaving a yellow ground.

Logwood blacks on "woaded" bottom.—Hydrochloric acid, no immediate change; in a few minutes a dull purplish stain. Strong nitric acid brings out a reddish liquid, and leaves a yellowish brown colour.

Aniline blacks. (On cotton.)—No immediate change with strongest hydrochloric acid. After fifteen minutes the swatch is a yellowish green, and the liquid olive brown.

Bleaching Powder.—(*Bleaching Lime, Chloride of Lime, Hypochlorite of Lime.*)—Concerning the preparation of this important chemical, nothing need here be said. When good it is a perfectly dry white powder, with a faint smell of chlorine gas. If kept in a damp place it absorbs moisture, becomes clammy to the touch, and smells more strongly, becoming at the same time rapidly deteriorated. It should, when fresh, contain on an average 35 per cent. of available chlorine. If badly made, or kept too long, it

frequently falls far below this standard. The value of a sample can only be satisfactorily judged by chemical analysis, so-called "practical" tests, being fallacious.

The following methods may be used: A standard test-liquor is prepared by dissolving 100 grs. of pure arsenious acid at a very gentle heat, in pure hydrochloric acid. When dissolved, distilled water is added, so as to make up a volume of 10 fluid ounces. Each ounce represents, of course, 10 grs. of arsenious acid.

To test a sample of bleaching powder, 100 grs. are fairly taken and rubbed well up in a porcelain mortar with a little water. It is gradually rinsed into a measuring glass, and water added sufficient to make up 2000 grain measures. The mixture is well stirred up and a pourette filled therewith. Each degree of the pourette contains, of course, one half-grain of bleaching powder. A fluid ounce of the arsenic solution is now put into a beaker glass, and coloured distinctly, but not strongly blue with a little sulphate of indigo. The solution of bleaching power is now gradually and carefully dropped into the arsenic liquor with constant stirring, till the blue colour disappears. The number of degrees required for this purpose, represent exactly 7·17 of available chlorine, and as each degree contains one half-grain of bleaching powder, the amount of chlorine in 100 grains is readily calculated. Thus suppose 20 degrees of the pourette have been consumed, then 20 : 100 = 7·17 : 35·85 the per centage of available chlorine contained in the sample under examination.

Another process is to dissolve 100 grs. of arsenious acid, and 292·7 grs. of crystallized carbonate of soda, both, of course, perfectly pure, in 10 ozs. of water. One oz. of this liquid is placed in a beaker, and the solution of bleaching powder, prepared as in the last process, is dropped in till a drop of the solution, taken out with a glass rod, gives a blue stain upon the following test-paper:

Heat together 15 grs. of iodine, 105 grs. of crystalline carbonate of soda, 45 grs. of potato starch, and 10 fluid ozs. of water till the mixture turns colourless, when it is made up to 40 ozs. with distilled water. White paper is saturated with this liquid, and preserved for use in a slightly damp state.

Bleaching soda, chloride or hypochlorite of soda, is now rarely met with. It is examined in the same manner as the corresponding lime compound.

Bleaching magnesia is every way preferable to either the lime

or soda compound. Consumers can readily prepare it for use by mixing a saturated solution of bleaching lime with one of Epsom salts, leaving the latter slightly in excess, and drawing off the clear liquid.

The available strength remaining in solutions of bleaching lime, which have been in use, may be most readily ascertained by Crum's method. This is as follows: protomuriate of iron at 40 Tw. is mixed with an equal measure of acetic acid at 8° Tw. A dozen phials being provided of clear white glass, equal in size and alike in shape, an equal portion of the mixture is put into each, enough to occupy one-ninth of each phial. Bleaching liquors are now taken of twelve different strengths, beginning with the strongest used, the others being let down with successively greater and greater quantities of water till we reach the weakest state to which the liquor is brought by use. The twelve bottles are then filled up, one with each strength. They are then marked, stoppered, and put aside for reference. When it is desired to find the strength of a partially spent bleach-liquor, we take a phial of the same size and make. One-ninth part of it is filled with the same mixture of acetic acid and muriate of iron, and the bottle is then filled up with the bleach liquor in question. It is then compared with the 12 standard reference bottles of known strengths. The phial which it most nearly approaches in colour will indicate its strength with exactness sufficient for all practical purposes.

Blue, Distilled.—This misnamed article is merely an extract of indigo refined and purified. Clean white woollen rags are dyed with the ordinary extract at a temperature near boiling. When they have taken up as much colour as possible they are well washed first in cold and then in hot water. This is continued till the hot washings begin to be very faintly tinged with blue. The rags are then placed in a very weak hot solution of carbonate of soda, containing not more than one half pound of crystals to 10 gallons of water. This quickly takes up the blue colour. The rags, which retain a dirty brown colour are removed and the liquid, being acidulated with sulphuric or acetic acid serves for a finishing blue. It may be concentrated if needful.

Blue, Paris.—(*Bleu de Paris.*)—An aniline blue now rarely if ever used. It was formed by the action of anhydrous bichlo-

ride of tin upon aniline, the action being much more prolonged than in the preparation of fuchsine. It is now superseded by the blues prepared by the action of magenta upon aniline.

Blue Colours, detection of.—*a. Indigo, fixed in the vat.*—Smears a piece of white silk. Sulphuric and muriatic acids and carbonate of soda no action. Strong nitric acid changes it to a clear yellow. Chlorine destroys it.

Indigo as China blue.—Similar. After being destroyed by chlorine takes no colour if dipped in a decoction of logwood.

Indigo as pencil blue.—Similar with acids, alkalies, and chlorine, but take a red colour if dipped in logwood.

Indigo as extract, sulphate of Indigo.—Does not soil white silk. Stripped by strong alkalies. Yields to nitric acid more readily than a vat blue. The variety known as "navy blues" strips very like a vat blue. They resist ammonia and carbonate of soda, turn a greenish yellow with caustic soda sooner than a vat blue and yield more readily to nitric acid.

N.B.—The term "navy blue" is sometimes also applied to a kind of vat work.

Aniline blues.—Dilute acids, no change. Alkaline carbonates no change. Strong acids green, blue colour restored by washing in plenty of water. Caustic soda, a red-brown.

Prussian blues.—Dilute acids, no change. Strong nitric acid a green not restored by washing. Carbonated and caustic alkalies a rust colour distinct from the red shade produced by soda with the aniline blues.

Logwood blues.—Turned red by acids.

Mixed blues.—Vat and Prussian blues are frequently topped with one of the red woods, or with cudbear. In this case sulphuric and muriatic acids should be applied, at first dilute and afterwards concentrated, noting if the liquid is reddened. If so, wood or weed colours are present. If a mixed vat and wood blue is destroyed with nitric acid, the residual colour will be browner than that given by a pure indigo.

Ultramarine in pigment styles.—Wet the pattern with ether and alcohol to dissolve the varnish with which it may be possibly mixed, and then apply hydrochloric acid. Colour disappears with a smell of sulphuretted hydrogen.

Cobalt in pigment styles.—Will not be discharged when treated as above.

Borax or Biborate of Soda.—This salt consists of soda combined with two equivalents of boracic acid and ten of water. It has feeble alkaline properties, and were its price more moderate would be extensively used for cleansing goods preparatory to dyeing and printing, its action being milder than that of the hydrated and carbonated alkalies.

It has also the power of dissolving various colouring matters, especially such as are of a resinous nature, a property which in the hands of judicious colourists has led to valuable and unexpected results.

Borax is soluble in two parts of boiling and twelve of cold water.

In dyeing with the Nicholson and Guernsey blues and Pomona green a bath made alkaline with borax is frequently used for getting the colour upon wool or worsted.

Borax Powder, French.—This article has disappeared from the market after a short and—for the sellers—brilliant career, and is mentioned now merely as a caution to purchasers.

About ten years ago an article was offered to woollen dyers for cleansing wool, preparatory to dyeing. It was stated to have the same properties as ordinary borax, being merely in powder instead of crystals, and being offered at half the price, it met with ready purchasers.

When brought into use, it was found to cleanse the wool most effectually, leaving it, however, rather harsh to the feel, and leaving a white powdery residue. One purchaser, however, feeling somewhat sceptical took chemical advice, and learned that the wonderful cheap article was merely soda-ash finely ground and mixed with sifted quicklime, in such proportions that the mixture when introduced into boiling water would furnish caustic soda! Of course, as soon as this secret oozed out, the sale of the article came to an end.

Brauna Wood.—A Brazilian dye wood not in general use. Its colouring matter has a great attraction for cotton, upon which it can yield, alone and with different mordants, a variety of sad shades, from blacks to drabs and fawns.

Brasil Wood.—A soft red wood, produced by *Cæsalpinia cristata*, a tree growing in Brazil. The wood is brought over in irregular knotty masses. When freshly chipped it has a yellow

colour, but on exposure to air and moisture it turns reddish. It may be readily distinguished from barwood and the other hard red woods, by the circumstance that it speedily imparts a bright red colour to water. It does not contain the bluish colour found in logwood, and the precipitates which its watery extract gives with the salts of tin and alumina, are red without a purple cast. Its colouring principle has received the name Brazilein, and is by some supposed to be formed by the oxidation of a colourless body, Brazilin, which bears to it the same relation as white indigo does to blue.

The colour of Brazil wood, like that of logwood, appears to be developed, or at least made more available by prolonged exposure to air and moisture after rasping. It is also, if allowed to lie too long in large heaps, subject to heat, but it is not so rapidly deteriorated in this manner as logwood.

The colouring matter of Brazil wood and its congeners is fugitive, and is especially affected by exposure to light. Mordants lessen, but do not entirely remove this evil.

Brazil wood and the remaining soft red woods, are largely used in dyeing so-called mock crimsons, in imitation of those produced with cochineal. In scarlet and crimson coburgs, and other mixed goods, the cotton warp is also got up with wood of this class in conjunction with a per salt of tin. In clarets and browns, it is also a very important ingredient.

The extract or decoction of Brazil wood, is used by dyers at from 5° to 10° Tw., and by printers at 20° Tw. or upwards. It is often "sprung," or weighted with common salt and nitrate of soda, which add to the specific gravity without improving the colour, and even diminish its affinity for the fibre. Its detection may often be effected by the taste. If this is not practicable, a little of the liquor is heated with some pure nitric acid till the colour is destroyed. The residual liquor is mixed with distilled water, and some solution of nitrate of silver added. If any common salt was present this will occasion a white curdy precipitate.

Extract of Brazil wood improves with keeping, as it becomes freed from a tarry matter, which, whilst it is held in solution or suspension, deteriorates the colour.

A paste extract is also sometimes met with in commerce.

Bromine.—A liquid elementary, or simple body, intermediate

in its properties between chlorine and iodine. It destroys vegetable colours. It is capable of replacing iodine in the preparation of certain coal-tar colours, but on account of its high price has not any practical application.

Bronzes.—By this term I mean all substances which combine with their colour a strong opaque metallic lustre. Some of these substances are metallic alloys finely laminated, and then ground to an impalpable powder. Others are insoluble mineral powders, and others are lakes or compounds of organic colouring matters with alumina, etc. They are all included in the class of pigment colours, and can only be applied to the fibre in printing by means of some varnish, or other appropriate cement, such as albumen or caseine.

Many attempts have been made to deposit reduced metallic films with the needful regularity, either in designs, or over the whole surface of a piece, or to produce "frosted" effects. But no satisfactory results have been reached. With the exception of gold, which is too costly, the other metals easy of reduction have unfortunately a very strong affinity for sulphur, and when deposited in a thin film over any kind of tissue, they are rapidly blackened, and rendered unsightly.

Broom.—(*Genista Tinctoria.*)—A shrub formerly employed for producing yellow colours upon wool. The shades obtained were much inferior to those produced by quercitron bark, fustic, etc., and it has, in consequence, been abandoned.

Buck-wheat.—(*Polygonum fagopyrum.*)—The leaves of this plant contain about one tenth per cent. of a yellow colouring matter, identical with the *rutine* found in common rue, and the *ilixanthine* obtained from the leaves of common holly.

The colouring matter is sparingly soluble in cold, but readily in boiling water and in alcohol. The watery solution gives to mordanted cotton, shades of considerable beauty. The colour dissolves in alkalies, forming deep yellow solutions, from which it is again thrown down on adding an acid. Muriatic and sulphuric acids change its colour to a deep orange. With salts of lead it forms a bright yellow lake.

This colour is not at present an article of commerce.

The leaves of buck-wheat yield, it has been asserted, a quantity

of indigo blue on being exposed to fermentation. Dr. Schunk, however, after a very careful investigation, was unable to detect a trace of blue colouring matter.

Burling Inks.—When woollen goods are dyed, they very frequently exhibit a greater or less number of small spots which refuse to take the colour. These spots or "burls," arise from portions of cotton intermixed with the wool, and which, not having the same affinity for the dye escape uncoloured.

To remedy this, the entire piece is either passed through baths capable of producing upon the cotton a shade, similar to what exists upon the wool, or, suitable liquids called "burling inks," are applied to the spots by means of a blunt pen.

A good burling-ink must *cover* well, that is, must entirely hide, the white or greyish spot to which it is applied.

It must agree in colour with the dye upon the wool as to be incapable of detection.

It must not leave, when dry, any glaze or shine upon the spot, as if gum-water had been applied.

Lastly, it must not have any injurious action either upon the texture or colour of the cloth.

Cam Wood.—(*Kambe Wood*)—Cam wood is obtained from Sierra Leone, the Gaboon, and other parts of the West Coast of Africa. It belongs to the second or hard section of the red woods.

It yields its colouring matter to water much more readily than barwood and sanders, but much less freely than Brazil wood or any red wood of the soft class. Hence, no true permanent extract of cam wood can be said to exist, since boiling water, charged with its colouring principle, re-deposits the same on cooling, and retains merely a trace.

Cam wood differs in other respects from Brazil wood and its allies. They are fugitive, whilst cam wood yields exceedingly fast colours. It contains two tinctorial principles, a red and a yellow, and hence under all circumstances, yields colours more inclining to scarlet than those furnished by Brazil wood.

It contains a considerable amount of tannin, and gives with solutions of iron a blackish precipitate; protochloride of tin turns the liquid a bright crimson, and alum gives a red colouration.

Caoutchouc.—(*India Rubber, Gum Elastic.*)—A gum-resin

found in small quantities in the sap of many vegetables, and obtained commercially from several trees indigenous in the tropical parts of Asia and America. It dissolves in mineral naphtha, benzole, and bisulphide of carbon, and has been tried in this state for fixing pigment colours in printing.

Carajurn or Chica.—A red dye ware obtained from the leaves of *Bignonia chica*, a plant growing on the Orinoco and Rio Meta. The dried leaves are extracted with water, and allowed to ferment, during which process the colour is thrown down in a fine powder.

It occurs in commerce in cakes about 6 to 8 inches broad, and 3 to 4 thick, of a blood red colour. Under the pestle it acquires a golden green lustre. It is very sparingly soluble in alcohol and ether, and totally insoluble in water. The colouring matter is probably combined with some earthy matter, whence it requires a treatment similar to lac. If treated with acids, or acid mordants, it gives full shades upon wool and upon prepared cotton. It appears to be used, to some extent, in the adulteration of cochineal.

Some authorities, *e.g.* Virey, maintain that chica and carajurn are distinct wares, the former alone being the product of the *Bignonia chica* from Venezuela and Guayana, whilst carajurn, crajuru or caracuru is obtained from the interior of Brazil, and has a much redder, brighter, and more beautiful colour. It is described as a powder or collection of irregular fragments, devoid of smell or taste, insoluble in water but completely dissolved by alkalies, and reprecipitated by alkalies, furnishing a strong and beautiful dye.

When carajurn is treated with soda, glucose, and water in a stoppered flask, as in the reduction of indigo, a violet solution is obtained, which becomes immediately brown on exposure to the air. If run into muriatic acid without access of air, a reddish-yellow precipitate is formed, which dissolves in a large amount of water with a yellow colour, and is turned a purple-red by carbonate of ammonia.

Carbolic Acid.—(Known also as "phenic acid," and as "hydrate of phenyl.") —A colourless oily liquid, having no action upon litmus paper. It has the specific gravity of 1·062; possesses a very peculiar odour and a burning taste. If applied to the skin

it excites blisters and is highly poisonous if taken internally. With due care it may be obtained as a crystalline solid body, which melts at 94° Fahr., and boils at 356° Fahr.

Carbolic acid has become of importance in the arts as being the material whence picric acid and peonine are prepared.

In addition, it has its direct applications. Whenever it is desirable to prevent any organic matter from undergoing those changes commonly known as fermentation and putrefaction, carbolic acid is the most powerful and appropriate agent.

Carbonic Acid.—A gaseous acid evolved during fermentation, the respiration of animals, the combustion of bodies containing carbon, etc. It constantly exists in the atmosphere to a small amount. It gradually combines with caustic potash, soda, ammonia, etc., left exposed to the atmosphere and converts them into carbonates. It is not known to exert any destructive or modifying influence upon colours.

Carmine.—The finest portion of the colouring matters of cochineal freed as far as possible from impurities and combined with alumina.

The name is also improperly used for carthamine, the red colouring matter of safflower.

Still more incorrectly it is applied, especially by French and German writers, to a neutralised extract of indigo or so-called soluble indigo, which in foreign receipts are often styled indigo-carmine, or carmine of indigo.

Carthamine.—(Sometimes erroneously called carmine.)—The pure red colouring matter of SAFFLOWER, in a concentrated form, not, however, in solution, but merely in suspension.

Good carthamine should be rather of a scarlet than of a crimson tint. If it is crimson it is a sign that the particles of colour are in too dense and compact a state, and consequently will not dye as brightly as desirable. It gives a delicate golden green stain if allowed to evaporate upon the finger nail.

The best method of comparing samples of carthamine is to dye with them equal weights of clean cotton cloth and compare the results.

Caseine.—One of the nitrogenous albuminoid substances

used for "animalizing" vegetable fibre and thus enabling it more readily to take up colours.

It occurs naturally in milk, from which it separates as curd. It agrees almost exactly in its composition and properties with legumine, the nitrogenous principle of peas or beans. It is separated from milk—all fatty matter having been previously removed—by dilute acids. It dissolves readily in ammonia, the alkaline carbonates, borax and lime water, with which it forms feeble combinations.

Caseine is distinguished from albumen by the circumstance that it does not, when existing in dilute solutions, become insoluble when heated.

When used as an animal mordant it is less fast than albumen, but its cheapness causes it to be very extensively employed. It is generally dissolved in ammonia, which escapes on exposure to the air, or on the application of heat, leaving the caseine deposited upon the fibre.

Catechu, Cutch, Gambir. (Formerly called TERRA JAPONICA.) —These dye-wares are the juices of certain trees, evaporated down to dryness. The several varieties differ according to the kind of tree whence they are obtained, the country where they are produced, the manner of preparation, and the degree of care expended on its preservation and transmission. The trees from which it is mainly obtained are the *Acacia catechu* of the Malabar coast and the *Uncaria Gambir* of Pegu. A certain quantity is also manufactured from the nuts of *Areca catechu*.

It appears in the market in large blocks or bales, weighing from 2 to 3 cwt.; in round cakes varying in colour from light brown to black, and weighing from 8 ozs. to 2 lbs.; in irregular roundish lumps like a flattened orange, and in square masses of 2 to 3 ozs. in weight.

Its texture is resinous, and if good, sufficiently brittle to break under the hammer. The colour, however dark outwardly, should be a brownish cream colour within. If it is deep brown throughout, and soft and pitchy in consistence, so as to cling to a knife, it has become impaired in quality either by long keeping, or by exposure to moisture. It should contain at least half its weight of tannin, varying in this point from 37 to 56 per cent. The tannin of catechu is not absolutely identical with that of the gall-nut. It gives not a blue-black but a greenish-black or olive

precipitate with the per-salts of iron, and with solutions of the tartrate of antimony and potash forms no sediment. It is also more soluble both in water, and alcohol than normal tannin.

Along with tannin, catechu contains a quantity of a peculiar body named catechin, or catechuic acid, which plays a considerable part in its reactions. This body when pure forms white silky crystalline needles, slightly soluble in cold but readily in hot water. If its solutions are exposed to the air they gradually pass into a mixture of rubinic and japonic acids.

Catechu is entirely soluble in hot water, if genuine. The brown solution, when cold, lets fall a sediment, containing the bulk of the catechuic acid. Cold water does not entirely dissolve catechu except it has previously been modified by exposure to damp, or by age.

The solutions of catechu are brightened by acids and darkened by alkalies. With per-salts of iron they give olive-green precipitates, those with proto-salts of iron being of a more brownish shade. It precipitates salts of tin with a yellowish, and salts of lead with a dull-reddish colour. Salts of copper and bichromate of potash give brown precipitates.

With concentrated nitric acid catechu yields a modified picric acid which dyes shades resembling those obtained from turmeric.

There are also rumours of a beautiful and fast catechu purple for which the following obscure recipe is in circulation:—Treat the catechu with dilute sulphuric acid by which it is resolved into grape sugar and a brown resin. The latter when dissolved in sulphuric acid, or in an alkali, gives the purple in question.

Catechu besides being naturally various in quality and liable to deterioration from time and neglect, is frequently adulterated with clay, sand, ochre, etc. The detection of these impurities is very easy. The sample is boiled in water and the decoction strained, when all such admixtures remain and may be dried and weighed. The amount of tannin may be determined as in DIVI-DIVI. The applications of catechu in dyeing and printing are numerous and important. It enters into a great variety of compound colours, such as olives, dark greens, drabs, fawns, browns, and blacks, to all which it imparts a high degree of permanence. It is abundantly used in combination with madder and garancine.

It cannot serve like the ordinary forms of tannin, as a mordant for fixing light or bright colours upon cotton, since it imparts a yellowish-brown colour to the fibre.

Chayavra.—A plant of the madder family, capable of dyeing similar colours. It is abundantly used in India, but is not met with in European markets.

Chemic.—A name given in some parts to the acid extract of indigo, unmixed with salt or soda.

In other districts it is given to bleaching liquor and bleaching-powder.

Chestnut.—Chestnut bark and wood belong to the astringents. The ground bark and an extract prepared from the wood, are sometimes used for adulterating ground myrabolans, and extract of logwood. On the continent, they are sometimes used as substitutes for galls and sumac.

Chinese Green.—(*Lo-kao.*)—A simple green colour, whose nature and origin are still involved in obscurity. About twenty-six years ago, reports reached Europe, of a dye possessed by the Chinese, resembling indigo in many of its properties, and applied in a similar manner. Specimens of fabrics dyed with this lo-kao were brought over, and their colour on examination proved to be not a compound of blue and yellow, but a green, one and indivisible. At last samples of the colour itself arrived. These were thin scales and plates of a dull green substance, very sparingly soluble in water, ether, and alcohol. By means of alkaline solutions it was found soluble, or at least was brought into a fine state of suspension, like the colouring matter in extract of saffflower.

It was found to dye upon silks a fine and stable green, which like the aniline greens, retained its beauty when viewed by artificial light. Lime was found to be necessary in the process, and had to be added to the water, if this was not hard by nature. The colour was, however, exceedingly costly. The Chinese, however, dye common cottons a deep green with lo-kao, whence it appears probable that the colour, as it reaches Europe, is not in its original state. Lo-kao is very difficult to meet with, and is superseded, for all practical purposes by the aniline greens.

Chinoline Blue.—A fine blue colour obtained from the residues occurring in the extraction of quinine from cinchona bark.

Its excessive sensitiveness to light, soon caused its use and manufacture to be abandoned.

Chlorophyll.—The green colouring matter of the leaves and stalks, etc., of vegetables. It is insoluble in water, but dissolves in ether, alcohol, acids, and alkalies, forming green solutions, which are readily decolourized by chlorine.

In the attempts made to use it as a dye, grass has been first boiled out in water, and the colour extracted from the residue, by a very weak lye of carbonate of soda, from which the chlorophyll is thrown down as a paste, by the cautious addition of an acid.

It has been experimentally used in dyeing and printing, but not with satisfactory results, as it is dull, fugitive, and very low in tinctorial power, and consequently expensive.

Xanthophyll and erythrophyll, are yellow and red colours, found in decaying leaves. They are of no practical importance.

Chrysammic Acid.—A coloured body obtained by the action of strong nitric acid upon aloes. When purified by washing and crystallization, it forms golden-yellow crystalline scales, soluble in hot water with a purple colour, also in alcohol, wood spirit, and ether. It explodes violently if heated. Its compounds with the alkalies are generally of a carmine-red colour, exhibiting a golden lustre, if rubbed in the mortar.

It has been used experimentally as a dye; but is not an article of commerce. (See ALOES COLOURS, ETC.)

Chrysaniline.—An organic base of a fine yellow colour, formed along with rosaniline, by the action of oxidizing bodies upon aniline-oil.

It is very sparingly soluble in water, but dissolves readily in methylated spirit. It forms crystallizable salts with the acids. With the addition of acetic acid, it dyes fine orange-yellow shades on silk and wool, and is met with in commerce under the name Victoria orange.

Certain of its derivatives are interesting, and may not improbably become useful in dyeing.

Chrysaniline-red.—(*Diiodhydrate of Trimethyl-chrysaniline.*) —A tinctorial substance, as yet in want of a name that ordinary mortals may have time to utter.

Forms fine orange-carmine crystals, and in solution dyes wool and silk a colour between deep orange and scarlet.

Citric Acid, and Lime Juice.—A vegetable acid occurring plentifully in the juices of the lemon, lime, orange, currant, and many other fruits. It is prepared by neutralizing the juice of the fruit with chalk, and decomposing the citrate of lime, thus obtained, by means of an equivalent quantity of sulphuric acid. The acid liquid thus obtained is carefully evaporated till it deposits citric acid in crystals, which are purified by repeated solution and re-crystallization, and, if needful, bleached by filtering over animal charcoal.

When pure, citric acid forms clear colourless crystals of an intensely acid, though pleasant taste, soluble in their own weight of water at 60° Fahr., and in half their weight at 212° Fahr.

For manufacturing purposes, citric acid is often employed in the state of lime-juice, which, if genuine, differs very little in its properties from the solid crystallized acid, and is capable of replacing it in nearly every case. It is a thick-flowing dark-coloured liquid, containing from 26 to 36 per cent. of actual citric acid, and marking from 45° to 54° Twaddle.

It is ordinarily sold at so much per gallon, per degree of a hydrometer specially constructed for the purpose, and which is erroneously supposed to give the amount of actual citric acid present. All such instruments are necessarily fallacious. The only way to ascertain the comparative value of samples of lime-juice, is after having found that no other acid is present, to determine the amount of citric acid by an acidimetrical assay. (See ACIDIMETRY.)

The adulteration to which crystalline citric acid is most liable, is tartaric acid. To determine this, dissolve a portion of the sample in as little water as possible, and add a saturated solution of the nitrate, or the sulphate of potash. If any tartaric acid is present, a white crystalline precipitate will fall to the bottom of the glass, although when the quantity is very small, some hours may elapse before this appears.

Sulphuric acid is occasionally present, not so much as an intentional adulteration, as an impurity arising from mismanagement. If so, the crystals will be damp, and when dissolved in distilled water, mixed with pure hydrochloric acid, and tested with a solution of the chloride of barium or nitrate of baryta, will give

a white precipitate. In lime-juice and lemon-juice, sulphuric acid is found in quantity as an intentional adulteration.

Crystals of citric acid, when strongly heated, leave no residue. Samples of lime-juice, even when genuine, must be expected to leave a saline residue after being evaporated down and heated to redness, from the potash naturally present in the juice of the fruit, but if the quantity be considerable, potash has been added to raise the specific gravity of the liquid.

Besides these impurities, lime-juice may be bad, by having been made from inferior or decayed fruit, and by being overloaded with what is called extractive matter.

Citric acid, and especially lime-juice, are used for precipitating CARTHAMINE from its alkaline solutions, and as a resist for iron and alumina mordants, having the power of preventing these bases from attaching themselves to the fibre in its presence.

Clay, Devonshire.—(*Pipe Clay, Cornish Clay, China Clay.*)—These clays differ from the common kinds in being free from iron, and consequently of a white colour. They are sometimes used by the printers as resists, and they are abused for adulterating lake-colours and other pigments. It must be remembered that alumina precipitated from a solution along with any colouring matter, and alumina added in its insoluble state to a pigment, are totally distinct in their nature and results. The former is consistent with perfect beauty in lakes,—the latter invariably deteriorates.

Cochineal.—A small insect, parasitical on the nopal, a species of the cactus, cultivated in Mexico and the Canary Islands. The females which are by far the most numerous, have no wings, and the legs are very imperfectly developed, which gives the insect the appearance of a shrivelled berry.

In appearance, samples of cochineal vary greatly, some kinds seem covered over with a whitish powder, and are known as silvery, others are a deep black, and others dark grey, mottled with red.

The colouring matter of cochineal appears to have acid properties, and is known as carminic acid. When pure, it is a violet brown, brittle substance, readily soluble in water and alcohol, also, without decomposition in concentrated sulphuric and muriatic acids. Sulphate of alumina forms with its solution a beautiful crimson lake on the addition of a little ammonia, as do

also the salts of tin. The acetates of lead, copper and zinc, give purple lakes.

Cochineal not only varies greatly in the quantity and quality of its tinctorial matter, but is subject to various sophistications. The "silvery" sorts are coated with weak gum water, and then dusted over with French chalk, heavy spar, or carbonate of lead. Inferior reddish-grey samples are also turned into silvery by the same process. Black sorts are weighted in a similar manner with finely-powdered black lead. Sometimes a portion of cochineal from which a part of the colouring matter has been extracted, is dried and mixed up with the fresh lots.

To select good cochineals much precaution is therefore needed. The grains should be full and plump, of a very dark colour, and of a glossy appearance. This glossiness is, however, sometimes produced upon inferior qualities with the aid of oil. As a rule, silvery sorts are not trustworthy, and in the reddish-grey mottled kinds, the colouring matter is generally immature, and deficient both in quantity and in brightness. All samples should be rejected which feel gritty and are found mingled with sand, small stones, and bits of clay, of about the size and shape of the grain.

After noting these outward appearances, the next point is to determine, in an approximate way, the specific gravity of the samples. It must be understood that the substances used as sophistications are very much heavier than genuine cochineal, and cannot be added to it in a remunerative quantity without making a given measure of the article very decidedly heavier than it ought to be. To apply this test in the most satisfactory manner, weighed portions of the respective samples should be dried at a temperature of 212° Fahr., and the loss of moisture—which may amount to 12 per cent.—should be noted. In good samples it will not exceed 5. The next step is to take a small glass, such as a Rham's specific gravity bottle, or, in default, a two-fluid-drachm measure, tare it very carefully, and fill it exactly full of the dried cochineal. This must be done not by pressing, but by gently shaking the glass and tapping it with the haft of a knife. It is then weighed. The quantity of good cochineal that will fill a two-drachm glass, will range from 60 to 66 grs., whilst bad qualities will reach 80, 90, and even 100. This test, which is very simple, and can be more rapidly applied than any other, will generally be sufficient. So far it is infallible that a heavy sample cannot be good.

Others propose to gain the same end by burning weighed portions to ashes, and noting their weight, which will of course be greatest in adulterated sorts. To execute this method in a satisfactory manner, requires, however, more time and a considerable amount of manipulative skill, since cochineal is not easily reduced to an ash perfectly free from carbonized organic matter.

If time sufficient is allowed, and it be desirable to examine farther, a colour test is next applied. Equal portions—say 5 grs. each—of the samples are reduced to a fine powder and placed in clear glass tubes, or phials, of equal calibre. Upon each is poured 1 fluid oz. of spirit of wine, and the whole are exposed, loosely stoppered, to a gentle heat with frequent shaking. After two or three hours have passed, the tubes are examined by a north-light, and the intensity and purity of the colours compared.

Or 20 grs. of each sample are reduced to a very fine powder and dissolved with the aid of a gentle heat, in 2 ozs. of a weak solution of caustic soda, or potash; 4 ozs. of water are then added, and the whole is set aside to cool. A pourette, graduated into 100 equal divisions is made up, and is filled with 5 grs. of pure red prussiate of potash, dissolved in a sufficient quantity of water. This liquid is gradually dropped from the pourette into the solution of cochineal, till the purple colour of the latter is destroyed and changed to a dull reddish brown. To detect this change of colour, drops of the liquid may be applied with a glass rod to a white plate. The sample which requires the largest amount of the test-liquor is, of course, the best.

Good cochineal contains about 50 per cent. of colouring matter which it yields to boiling water. It must be remembered that here, as in the case of several other wares, the whole of the colour is not alike in quality. The portion most readily dissolved out, is by far the finest and brightest, whilst what remains is much duller in tone. This fact is of great importance in the manufacture of the pigment carmine.

The uses of cochineal scarcely need to be mentioned. It serves to produce scarlets, reds, crimsons, and pinks, upon woollen and worsted goods. Its proper mordant is tin. For silk, its affinity is less, and for cotton least of all. Indeed, a cochineal scarlet upon cotton is a desideratum not yet realized.

Colloids.—In contradistinction to crystalloids stand colloids, or

colloidal bodies, so named from glue, which is a familiar specimen. Bodies of this class when re-assuming the solid state after solution never take any regular specific geometrical form. Whether evaporated slowly or rapidly they dry up in irregular masses, which if struck, break up as easily in one direction as another. Familiar examples of colloid bodies are gelatine, gums, and albumen. They are readily separated from the crystalloids by the process of dialysis.

Colorin.—A preparation of madder, differing little from Azale. Garancine is exhausted with ordinary methylated spirit; the liquid is filtered from the grounds and the spirit is then evaporated at a low temperature in a kind of still. The solid matter remaining behind is colorin. It is an impure modification of ALIZARIN, and is not very extensively used.

Colours.—In the tinctorial sense, this term is applied solely to bodies which are capable, either alone or by the intervention of a mordant, of imparting a colour to animal and vegetable fibre, that is, of enabling its surface to reflect some particular ray—or set of rays—of light. Many bodies, brightly coloured in themselves are utterly incapable of doing this, since they can neither be ground to powder nor brought into a liquid state without their colour entirely disappearing. We may instance the opal, fire-marble, Labradorite, peacock coal, etc.

A further limitation is practically needful. Many substances are capable of altering the shade of wool or cotton which is boiled or steeped in their extract or solution, but the shade thus produced is a mere stain, void of body and of permanency.

Colours in this restricted sense are divided into two classes: *dyes*, which are capable of solution, and *pigments* which are applied in the solid state, as they cannot be dissolved without undergoing decomposition. The use of the latter class is confined to one particular style of printing.

The soluble colours or dyes must possess the following properties. They must be *soluble* either in water or in some liquid which can be mixed with water without decomposition, and which does not exert any injurious influence on the fibre to be dyed.

They must have an *affinity* for, or a disposition to attach themselves to the tissue to be coloured. Dyes which possess in themselves this affinity—as magenta, picric acid, safflower, indigo—

were called by Bancroft *substantive* colours. Those which require the intervention of some third body (see MORDANTS) to fasten them upon the fibre are named *adjective* colours. This classification is convenient, but not unobjectionable. A colour is generally found to be substantive upon one fibre and merely adjective upon another. It may be capable of fastening itself alone upon the fibre, and may yet be much improved by the intervention of a mordant.

Further a colour must either be met with pure or must be easily separable from any accompanying bodies which might stain or spot the goods, or produce an objectionable modification of the shade. Such accompaniments are the tarry matters generated in the manufacture of the aniline colours, the yellow in safflower, the fawn colour in madder, the green and brown colours in indigo.

Again, colours must possess what I may call *commercial permanence.* No colour known will when applied to silk, wool, or cotton retain its beauty undiminished for ever. The action of light, and air, and moisture, changes of temperature, etc., must in the lapse of years modify such complex combinations as those formed by a colour, a mordant, and an organic fibre. But the colour produced must be so permanent that the goods dyed or printed may bear rinsing off or otherwise cleansing, drying, pressing, and packing; may suffer no change during transit, pass safely through the merchant's warehouse and the draper's shop, and may after this still last a reasonable time in the hands of the purchaser. The experimentalist often—too often—comes upon colours of intense beauty which so far from fulfilling these conditions undergo spontaneous decomposition sometimes in the course of a few minutes.

The degree of permanence required varies very much according to the nature of the goods, and the circumstances to which they are likely to be exposed. Articles of dress which will only be worn once or twice, and that by artificial light, may be dyed with colours of a very fugitive class. Such goods as will have to be repeatedly washed, or will be exposed for a prolonged period to direct sunlight, rain and dew, sea-air, perspiration, friction, etc., must be dyed with colours of a very different nature. The piece-dyer will always know to what circumstances his work is likely to be exposed, and the dyer of wool, slubbings, silk and cotton skeins, and woollen or worsted yarns, would do well to ascertain.

The chief agencies which affect the permanence of colours will

require a brief notice. Foremost comes LIGHT, which see. Moisture likewise plays a prominent part in the alteration and fading of dyed and printed tissues, especially if applied in the form of dew. Almost every case of chemical decomposition proceeds more rapidly when the substance in question is in a moist state, whilst in a condition of perfect dryness the decay even of those animal bodies most prone to decomposition is arrested for an indefinite period. Before the discovery of chlorine, exposure to dew was the principal means of bleaching linen and cotton tissues. The reason probably being that dew contains a multitude of those semi-organic germs and spores which are the acting part of ferments, and which, wherever they go, are apt to set up decomposition in organic matter. The action of dew in injuring colours is well known. Consequently goods which will be exposed to its influence should be dyed with permanent colours.

Next comes the action of the atmosphere. Although no dyed goods are or can be wholly protected from the air, they are exposed to it in very different manners and degrees. The constituents of the atmosphere which interfere with colours are, in addition to watery vapour and ferments, oxygen in the active state (see OZONE), carbonic acid, SULPHUROUS ACID (which is always found more or less in the air of countries where coal is an article of fuel), sulphide of hydrogen, and sulphide of ammonium from decomposing animal matter, etc.

As far as articles of clothing are concerned, perspiration is a powerful agent for the deterioration of colours. Its most active constituent is lactic acid, a compound little less powerful than the mineral acids, and whose prolonged action scarcely any colour is able to resist.

Friction is another destructive agency. Not only the colours, if at all loose, are thus removed, but the very surface of the fibre to which the colour is attached will thus be abraded. As a test, goods are rubbed with a piece of clean white silk. If this is at all soiled, the dye is pronounced not friction-proof. This property is not generally demanded in piece-dyed goods, but wool yarns or skeins, which, when woven, will form patterns, are of very little value if the different shades are capable of respectively soiling each other. Printed goods also are worthless if the darker portions of the designs rub off upon white or light-coloured grounds.

Washing is a compound cause of injury, combining the destructive agencies of friction, moisture, soap—sometimes also soda

and ammonia—with subsequent exposure to air, light, and sometimes to temperatures considerably above that of boiling water, as in the domestic operation of "ironing." Few shades can undergo all these processes without showing some degree of deterioration. Hence the question, "Will it wash?" so generally put to merchants and drapers by purchasers of prints. Much, however, depends on the manner in which the washing is performed. Delicate colours may be washed by careful persons without the least injury, whilst in careless hands they would be hopelessly spoiled.

The permanence of a colour is also very much modified by the nature of the fibre to which it is applied. As a general rule, colours are faster upon wool than upon cotton, while silk holds an intermediate rank. In other instances, *e.g.*, indigo, the order is reversed, the colour being more permanent upon cotton than upon wool. The mineral colours also furnish unsatisfactory results upon animal fibre. This is especially the case when, like the salts of iron and lead, they are capable of being blackened by the action of sulphur.

From all this it will appear that a universal test by which the fast or fugitive character of a colour can be once for all ascertained is an impossibility. The only really practical plan is to expose the colour in question upon the kind of material in question to such influences as goods of the kind are expected to withstand, and note the result. But to conclude because a certain dye is not injured by soap-lyes, that it will therefore resist the sunshine and night-dews of a tropical climate is at once illogical and unbusiness-like.

Another quality which may be fairly demanded from colours is that they should exercise no injurious action either upon the dyer or upon those who may subsequently wear articles of dress made from the dyed materials. Here also there is latitude for judgment, according to the probable destination of the goods. We may safely say that no colour known to be poisonous, and to be capable of acting upon the system by absorption, should be used for dyeing articles to be worn in immediate contact with the skin. The recent outcry about "poisonous dyes" seems to me, however, exaggerated and sensational.

Colours vary to a very great extent in their tinctorial power, that is, in the amount of material which they are capable of dyeing. This depends, in part, on the amount of actual colouring matter present in the crude dye-wares, in which there is great difference.

Yet this is not all. If we compare two colouring matters in a state of purity, perfectly freed from all extraneous matter, we often find one possessing twenty times the available strength of the other. This difference is nowise indicated by a deeper apparent colour in the solution. Thus we may prepare two solutions of apparently the same depth of colour—the one of sulphate of indigo, and the other of an aniline blue—yet the latter will dye a much greater weight of wool or silk up to a given shade than the former. In like manner, a pale yellow solution of picric acid will dye more material than a decoction of fustic, which seems quite opaque with strength.

In all the chemical arts there is a growing tendency to substitute pure proximate principles for crude natural products. This tendency is strongly at work in the arts of dyeing and printing. The old dye-wares, as furnished by nature, generally contain several tinctorial principles, mixed in varying amounts with matters indifferent, or in some cases hurtful. Modern tinctorial chemistry seeks to effect a complete elimination of all matters hurtful or useless, and to isolate each true tinctorial principle, so that it may be used when, and only when, requisite, and in the exact proportion required.

The second class of colours, the *pigments*, are used in certain styles of printing only. They differ from the dyes spoken of above in being insoluble. Consequently, they can only be attached to the surface of the fibre, instead of to a greater or less extent pervading its whole mass. Many pigments, well adapted for the use of the artist or decorator, are valueless to the printer. The latter requires pigments which are not very opaque, nor too dense in their texture; otherwise, the designs have a dead, heavy, plastery effect, very unpleasant to the eye. But, at the same time, while they reflect light strongly, and seem semi-transparent, they must cover the fibre perfectly, and not allow any part of the ground to shine through. They must also be full, rich, and soft in tone, otherwise their effect is harsh and chalky. Thus red lead, used as a pigment in this style of printing, would be frightful.

The use of pigment colours in printing is greatly on the increase.

Colours, Examination of.—A few practical remarks on the examination of colours may be useful.

1. Whether the body in question be a dye—solid or liquid—

or a sample of printed or dyed goods, never examine it in direct sunlight. Select, if possible, a place lighted from the north, and where there are no objects liable to reflect false lights upon what you are examining.

2. The examination of colours is necessarily *comparative*, and demands that the object in question should be laid side by side with some standard. No man can safely say, "This piece matches that pattern; this shade is brighter or flatter than that;" or, "This liquid more intensely coloured than some other," except he has the two before him.

3. Very bright colours, such as scarlets, magentas, etc., soon fatigue the eye. They should therefore be examined, and compared quickly. Nothing can be gained by prolonged gazing.

4. The use of a lens, or any magnifying apparatus, is not only needless, but positively injurious. Colours are best appreciated by the naked eye.

Animal Colours.—The number of colours obtained directly from animals is very limited, consisting of murexide and cochineal. The former of these plays, however, in nature a part far wider and more important than it has yet succeeded in doing in the tinctorial arts. It must be noted that the most splendid colours of the animal world, or rather of all known beings, are found in birds and insects, the very tribes in which the secretion of uric acid is considerable. Now, as stated elsewhere, uric acid is the material from which murexide is elaborated. Further in the moulting season, whilst the new plumage is being developed, the uric acid found at other seasons in the excreta of the bird is wanting. This leads almost of necessity to the conclusion that it is wanted to furnish colours for the new set of feathers.

We must note here that whilst art has elaborated from uric acid only violets or purples, nature obtains from the same source greens, blues, crimsons, and scarlets of the greatest brilliance. Further, whilst murexide is a fugitive colour, the dyes found in the feathers of birds and the elytra of beetles, are permanent. There are, however, fugitive animal colours. The wings of butterflies, on prolonged exposure to light, fade, not alone by the mechanical abrasion of their minute feathers or scales, but by changes like those which affect our dyed and printed goods. We may thus distinguish in insects two distinct classes of colours, fast and fugitive. The fast predominate among beetles and hemipterous

insects, whilst the fugitive are met with more generally among butterflies, moths, dragon-flies, and certain of the wasp tribe, *e.g.*, the splendid *chryseis ignita*. Light and medium shades of a non-metallic kind, especially greens and pinks, are the most evanescent, whilst the irridescent colours, and all yellows and browns, even in butterflies, display great permanence.

Copper, Ammoniuret.—The precipitate which ammonia causes in solutions of the sulphate, nitrate, and other salts of copper, is easily redissolved on adding a further portion of ammonia, forming a liquid of a rich violet-blue colour. It has the property of dissolving cotton, which if steeped in it, first becomes a jelly, and is then perfectly liquified. From this solution the cotton is thrown down as a white powder on the addition of acids. This powder has the same chemical constitution as cotton, but retains no trace of fibrous structure.

Upon silk and wool the action of the ammoniuret of copper is less decided.

In a less concentrated state it may serve for dyeing pale greens upon cotton.

Copper, Nitrate.—This salt is met with of two kinds. Either metallic copper is dissolved in nitric acid till no more is taken up, or the sulphate of copper is dissolved in water, and then decomposed by adding an equivalent of the nitrate of lime, or of lead. The latter kind is most neutral.

Nitrate of copper forms crystals of a much deeper and purer blue than the sulphate, but as these are very deliquescent, and attract moisture, except preserved in stoppered stoneware vessels, they are very rarely met with.

The nitrate is commonly sold as a liquid of the specific gravity of 80° to 90° Twaddle, and as many purchasers judge of its strength solely by the hydrometer, it is largely adulterated with zinc, and a variety of other substances. If ammonia be poured into the liquid, the precipitate which is formed at first should entirely re-dissolve on adding more of the ammonia.

If a current of sulphuretted hydrogen gas be passed into the liquid nitrate previously rendered more acid by the addition of some hydrochloric acid and continued to perfect saturation, the liquid remaining when filtered off from the precipitate, and evaporated to dryness, and heated strongly, should leave no residue.

Much of the nitrate of copper now in the market is made, not by manufacturing-chemists, but by workers in metals, who use nitric acid to cleanse articles of copper, brass, etc., and who now sell the resultant liquor to dyers and printers at very low rates.

Nitrate of copper is now largely used in black-dyeing; and in printing is employed along with catechu for a class of browns; also in certain steam and spirit colours; and in resists for China blue.

Sulphate of Copper, called also Blue Vitriol, Blue Stone, and Roman Vitriol.—This salt is found in fine, deep blue crystals of a nauseously metallic taste, and liable to effloresce in a very dry atmosphere. It dissolves in half its weight of boiling water, and in three times its weight of cold water. The solution saturated at 62° Fahr. marks 36° Tw.

At temperatures about 212° Fahr., the crystals lose their water of crystallization, and become converted into a white powder, which, on contact with the minutest trace of water, turns blue, and thus may serve to indicate the presence of that liquid, *e.g.*, in alcohol.

At a red heat, blue vitriol is decomposed, leaving the oxide of copper as a black powder.

Sulphate of copper is contaminated with a variety of impurities. Of these, the most common is sulphate of iron, which may be present to a considerable extent without altering either the colour or the form of the crystals. To detect it, or any other salt of iron which may occur, boil the solution of the sample with a little nitric acid, and add ammonia in large excess. The oxide of copper thrown down at first is re-dissolved by the ammonia, but any trace of iron will be found in the shape of brown flakes floating in the liquid, and may be filtered off.

Another very common impurity is the sulphate of zinc. To detect it, pass a current of sulphuretted hydrogen gas into the solution of the sample to which a little pure hydrochloric acid has previously been added. Filter off the black sediment (sulphide of copper); evaporate the clear liquid to dryness, and apply a strong heat. Nothing will remain if the blue vitriol was pure, whilst oxides of zinc, manganese, magnesia, etc., will remain, if any of these bodies was present.

The uses of sulphate of copper in dyeing and printing are not very extensive.

Copperas, or Green Vitriol.—A name familiarly given to the protosulphate of iron, probably from the old and mistaken notion that it contained copper. It is generally prepared from the soft white variety of iron pyrites frequently found to an immense extent in the coal-measures. These, on exposure to air and moisture, decompose the latter, taking up oxygen, and are thus converted into sulphate of iron. Should the sulphuric acid thus generated from the mineral be more in amount than the iron is capable of saturating, a quantity of iron scrap is added to the liquid which drains from the pyrites-beds.

Copperas forms pale greenish-blue, semi-transparent crystals, containing 45 per cent. of water. If this is expelled, there remains a white powder. The crystals dissolve in one and a half times their weight of cold, and in one-third of boiling water. On long exposure to the air, they become covered with a brown rusty coating, especially if damp, owing to the formation of a portion of sesquioxide of iron.

Copperas should be well-drained from the mother liquor; the crystals clean and hard, and of a decided green colour. If of a dull whitish or greyish green—or as it is technically called milky—the presence of alumina is to be suspected.

To detect this, boil a small portion with pure nitric acid. Add *pure* caustic soda—that prepared from metallic sodium to be preferred—in large excess; boil in a clean iron vessel and filter. Add to the clear filtrate a solution of pure sal ammoniac. If, on standing, a white precipitate appears, alumina was present in the copperas. To a small extent this impurity will be found in most samples, but if pyrites have been used contaminated largely with aluminiferous shales, or if the copperas has been crystallized from too concentrated solutions, it may rise to very serious proportions, and seriously impair the colours produced by the copperas. It is in all cases an impurity due to mismanagement, not to fraudulent intention.

Lime is sometimes dusted over copperas to give a newly-made article that brown spotty appearance, which some consumers prefer. To detect this dissolve a portion; add to the solution an excess of ammonia, which should be free from carbonic acid. Let the mixture stand in a glass jar with ground edges, which should be slightly greased and covered with a glass plate so as to exclude the air. When the precipitate has subsided, pour off a part of the clear liquid into a test glass, and add a solution of oxalic acid in

distilled water. If lime was present, a white precipitate will be formed on standing for a few minutes.

Zinc and copper may sometimes accidentally occur in samples of copperas, but only to a very small extent.

The direct uses of copperas in dyeing have very much diminished. For dyeing blacks upon wool in conjunction with logwood, it has been to a very great extent superseded by chrome. For blacks upon cotton, as also for saddening drabs, clarets, etc., the nitrate of iron is generally preferred. But the quantity of copperas consumed indirectly in dyeing and printing, as serving for the preparation of nitrate of iron is very large. It is also sometimes used in making pyrolignite of iron, and serves in dip blues and China blues.

Copperas, Calcined.—This is an article used occasionally by some dyers, though what benefit can be derived from its employment is very problematical. If it has been really calcined nothing can remain but the peroxide of iron, which being quite insoluble in water, will settle to the bottom of the dye-beck without any effect. If merely the water of crystallization be expelled, its action must be similar to that of fresh or raw copperas, since, as soon as it comes in contact with water, it will at once return to its ordinary state and dissolve as such.

Coralline.—(*Peonine*)—A deep red colouring matter prepared from rosolic acid by the action of ammonia at a high temperature.

It is now employed to a considerable extent, in silk and woollen dyeing, as well as in calico printing.

In tone it is perfectly distinct from magenta, being a red, as its names intimate, resembling that of the peony and of coral.

It is also much more permanent than magenta. Light and the alkalies affect it comparatively little.

An outcry is at present raised against its use, on the ground of alleged poisonous properties, which are probably much overstated.

Cork.—A fine yellow colour may be obtained by the action of nitric acid upon cork-cutter's waste. It was at one time employed in producing a fine and permanent shade upon silk and wool for fancy waistcoatings. It is not now in use.

The outer bark of the cork tree has also been employed in its natural state as a nankeen dye, but is now abandoned.

Cotton.—One of the principle modifications of lignine, or woody fibre. It has greater affinities for colours and mordants than most vegetable matters. In this respect, however, different kinds vary. The cotton of India dyes and prints about as well as the American, but that of Egypt is decidedly inferior. Portions of cotton sometimes occur, in greater or smaller quantity, which have no affinity for colour at all. This phenomenon is not satisfactorily explained; but in such fibres, the central tube appears to be filled up with a kind of pith.

By strong nitric acid cotton is readily converted into PYROXILINE or gun cotton, and is then soluble in ether; by concentrated caustic soda it is *mercerized;* by muriatic and sulphuric acids it is rapidly tendered and rotted, as also by mordants, which are too strong in acid.

Its affinities for the metallic colours are strong, whilst the weed—aniline—and phenol—colours can only be fully deposited upon it by means of animalisation.

Crimson Paste.—A preparation of cochineal and ammonia, used, as its name implies, in dyeing grain crimsons upon animal fibre. An actual chemical combination must ensue, between the colouring matter of the cochineal and the ammonia, since neither exposure to the air, nor heat, nor the addition of a large excess of oxalic acid, can restore the cochineal to its natural properties, or enable it to dye a scarlet.

Crystallization.—Many bodies when returning to the solid state—whether such liquidity has been caused by heat or by the aid of a solvent liquid—take a regular form, being bound by planes of a fixed number, meeting each other at certain angles. In one and the same kind of substance, crystallized under the same circumstances, these planes and angles are immutable. Hence such bodies may be recognized by their crystalline figure. These substances are in fact nearly always crystalline. If we evaporate their solutions down rapidly, we may obtain what at first appears a shapeless mass, but if examined under the lens, it proves to be an aggregation of tiny crystals. The substances which we call amorphous or shapeless, are generally the broken, or worn fragments of crystals.

Crystallization generally ensues when a hot saturated solution of a *crystalloid* body is allowed to cool. The more gradual the process, and the deeper the mass of liquid, the more perfect are the crystals.

Crystalloids.—Bodies which, when solidifying, take a regular geometrical form, invariable in each kind. They are distinguished from, and opposed to the COLLOIDS. (See CRYSTALLIZATION.)

Cudbear.—Cudbear is in its origin and properties very similar to archil, from which it differs mainly in being freed from all excess of ammonia, and from moisture, and in being reduced to a fine powder. It is sometimes purposely contaminated with mineral matter, such as salt, carbonate of lime, etc. These frauds may be detected by burning a weighed quantity of the sample to ashes. If genuine, the residue will be quite inconsiderable. Or weighed portions of cloth or woollen yarn, may be dyed with equal weights, when the deficiency of the sophisticated samples will appear.

Cudbear is used for dyeing ruby and maroon shades, as well as a variety of browns. Its consumption has been lessened by the introduction of certain coal-tar colours, such as "ruby," or aniline-crimson.

Datiscine and Datiscetine.—A colouring matter obtained from the roots of *Datisca cannabina*, a plant indigenous to the Punjab, where it is used to dye silks a permanent yellow.

The roots are of a yellow colour, and are generally found in pieces about six inches long and half an inch in thickness. Datiscine when pure is colourless, but forms bright yellow lakes with the salts of lead and tin. If boiled for a few minutes in dilute sulphuric acid, it is converted into datiscetine, which has a far higher tinctorial power.

Deliquescence.—Many bodies, crystalline or otherwise, on exposure to air, absorb a quantity of the moisture always present in the atmosphere, in which they dissolve if solids, or with which they dilute themselves if already in a liquid state. Chloride of calcium and sulphuric acid are familiar examples.

If placed in a shut-up apparatus, deliquescent bodies may be

employed to dry any other article placed along with them, without the aid of heat.

Dextrine.—(*Artificial Gum, British Gum, Gum substitutes.*)—When starch is exposed for some time to a high temperature, or boiled with dilute mineral acids, or heated in solution with ground malt, it undergoes a remarkable chemical change. It becomes soluble in water, loses the power of giving a blue colour with iodine, and becomes closely similar to the natural gums. As such, it is largely used by calico printers for thickening their colours. A variety of artificial gums are met with in trade, according to the kind of starch used as material, and the process employed for its conversion.

Gums should be free from grit, an impurity conveyed into them by the starch, and derived from the stones used in grinding the grains or roots, whence it is prepared. Its amount may be detected by boiling the sample in a mixture of nitric and hydrochloric acids, till the organic matter is entirely or nearly destroyed. The insoluble residue is then ignited to remove any residue of an organic nature, and the remaining grit is weighed. It is never entirely absent, but can not exceed one-fifth per cent. without becoming hurtful.

Sugar is often generated to some extent in the manufacture of gum, and remains mixed with the latter. It is injurious in many cases. Its presence can be detected by heating a portion with some solution of neutral chromate of potash, to which an excess of potash has been added. If sugar is present, the liquid will turn green.

In the absence of all impurities, however, the quality of gums varies greatly, and can only be judged by a practical colour-mixer.

Dialysis.—In his experiments upon diffusibility, the late Professor Graham found that soluble substances might be divided into *crystalloid* and *colloid* (*gluey*). The former alone were capable of passing through a vertical partition of membrane, whilst the latter remain behind. In this manner, bodies of the two classes may be respectively separated, either in analytical operations, or on a large scale for manufacturing purposes.

Diffusion.—If different solid bodies are placed respectively

in contact with equal volumes of the same fluid, as for instance water, it is found that they differ greatly in their power of travelling through the water. Some kinds pervade the whole liquid with which they are in contact, much more rapidly than others. This is called their diffusibility, and has no relation to their solubility. The same phenomenon occur when miscible liquids are placed in contact. In some cases decompositions, more or less complete, may be effected by taking advantage of the varying diffusibility of the substances concerned. See also ENDOSMOSE.

Divi-divi.—One of the most important of the class of astringents, or bodies containing tannin. It is composed of the bean-like pods of *Cæsalpinia coriaria*, a small tree found in South America, especially in the district of Maracaibo.

The pods are about 3 inches in length by 1 in breadth, and are generally folded up or bent, as if they had been exposed to a great heat. In colour they are brown, sometimes blackish.

They are much richer in tannin, than sumac or myrobalans; it is, however, accompanied by a kind of colouring matter, which greatly interferes with its usefulness in certain cases. The tannin is all found in the outer part of the pod, the seeds and the portion in which they are enveloped being inert.

Divi-divi pods should be selected thick and fleshy, and of as pale a colour as possible. Those of a very deep brown covered with black blotches, have been gathered when wet, or have been subsequently exposed to damp, which considerably injures their quality.

The comparative value of samples of divi-divi, may be ascertained as follows: A fair average is coarsely powdered, and a known portion of this—say 50 or 100 grs.—is weighed out and steeped for a known time in a pint of boiling water. Some clean white calico, which must be perfectly free from grease, stiffening, etc., is then weighed out and steeped for an hour in the infusion. It is then taken out, allowed to drain, and re-soaked in half a pint of *cold* water, to which 2 fluid drachms of nitrate of iron have been added. After being allowed to lie in this liquid, with occasionally turning for about 10 minutes, it is taken out, rinsed in cold water and dried. The patterns are then compared, when the intensity and goodness of the black colour they exhibit will give a good practical view of the strength and value of the samples.

The patterns may be preserved for reference.

The exact weights and measures used are of no importance, but whatever quantities, times, temperature, etc., are once selected should be noted, and ever afterwards adhered to, or the results will not admit of comparison. The nitrate of iron used should always be of the same make and specific gravity.

A much more accurate method, requiring some familiarity with chemical manipulation, but which in experienced hands, gives nearly the exact per centage of tannin found in the sample, is as follows:

The sample being fairly taken, is ground to a very fine powder. 50 or 100 grs. are then weighed out, placed in a small beaker glass, and boiled for a few minutes with a little distilled water, sufficient to cover the powder. While boiling, it must be occasionally stirred with a glass rod. The clear liquid is then poured off without straining or filtering, into another beaker, whilst a fresh portion of distilled water is poured upon the powder and boiled afresh. This is repeated four to six times, when all the decoctions, poured together into the second beaker are set aside to cool, being kept covered with a glass plate.

A standard test solution should have been previously prepared as follows:—1 drachm of dry uncoloured gelatine, is dissolved in 4 fluid ozs. of distilled water, with the aid of a gentle heat. When dissolved, 15 grs. of pure alum in fine powder is added, and dissolved in the liquid with occasional shaking round. It is then poured into a stoppered bottle and preserved for use, in a dark place, and, preferably at a temperature just sufficient to keep it from coagulating. 155 grs. of this solution are sufficient for 5 grs. of pure tannin.

To complete the operation, a quantity of the test solution is poured into a Schuster's alkalimeter, which is then weighed, and the weight noted. The test liquor is next carefully dropped from the Schuster into the beaker containing the decoction of divi-divi, till when a drop falls upon the surface, a ring-shaped spot is no longer produced. The beaker is then set aside for a few minutes that the contents may settle, when the clear liquid floating above the sediment is thus examined. Take a plate of black glass, or of common glass lying upon a sheet of black paper, and with a glass rod make upon it a couple of spots of the clear fluid. Add to one of these, a drop of the test liquor (A), and to the other (B), a drop of a solution of tannin, which should be kept at hand for

the purpose. If A shows a white turbidity, the liquor under examination will take a further addition of the test-liquor; but if B grows turbid, the mark has been over-stepped. Great accuracy may be reached if this spotting process is frequently applied, as the analysis draws to a close.

When all is over, the Schuster is weighed, when the loss of weight shows the amount of test-fluid consumed, every 155 grs. of which represent 5 per cent of tannin in the sample examined, if 100 grs. have been taken.

Or, after extracting the tannin from the sample by boiling in distilled water as above, add a solution of gelatine. The precipitate that forms is allowed to settle, the liquid above is carefully decanted off, and repeatedly washed with cold distilled water. It is then thrown upon a paper filter placed in a glass funnel, dried at a temperature of 212° Fahr. till it no longer loses weight, and weighed. 10 grs. of this precipitate signify 4 grs. of tannin.

Another method is as follows:—Prepare a standard solution by dissolving sulphate of cinchona in a known measure of distilled water. A very little magenta is added, just sufficient to give the liquid a distinct red colour.

A pourette is filled with this standard liquid. A grain of pure tannin is next dissolved in water, and the test-liquor is dropped very gradually and carefully into it from the pourette, till a faint pink tint appears in the glass above the precipitate which is first formed. Note the number of degrees of the pourette which have been consumed to bring about this result, and which will represent 1 gr. of pure tannin.

100 grs. of the sample under examination are now extracted with distilled water, as above directed. A pourette is filled with the cinchona liquid, which is then dropped into the decoction of divi-divi, till a faint permanent pink tinge appears in the liquid. The number of degrees of the pourette consumed being noted, and compared with the above-ascertained number, representing 1 gr. of tannin, the percentage of tannin in the sample will be seen at once.

The consumption of divi-divi for dyeing purposes is now very large. Since, however, its tannin, as already intimated, is accompanied by a peculiar colouring matter, divi-divi is more adapted for blacks and other sad colours, than for light and bright shades.

Another defect of divi-divi is, that being of an adhesive nature,

small fragments of the ground pods are apt to stick fast to the goods which are being prepared therewith. When these are washed away, it is found that they have acted the part of a resist, protecting the spots where they have adhered from the action of the tannin. Thus when the dyeing process is finished, the goods will appear spotted. To prevent this, the divi-divi is extracted in water, and only the clear liquor allowed to come in contact with the goods.

The tannin in good divi-divi may reach 48 to 50 per cent.

Efflorescence.—When a salt parts with more or less of its water of crystallization on exposure to dry air or heat, losing its form and transparency and falling to powder, it is said to effloresce.

Emeraldine.—An aniline-green produced direct upon the fibre, by Calvert and Lowe's patent. It may be considered as superseded by the Pomona paste.

Endosmose.—If a saline solution and a quantity of pure water, or two saline solutions of different strength be placed in a suitable vessel, and separated by a division of bladder or artificial parchment, a current is established towards the stronger solution, the water finding its way through the division until the strength of the two is equalized.

Erythric Acid.—A principle existing in orchella weeds. It is a perfectly white tasteless body, soluble in water, alcohol, and ether. Its solutions redden litmus paper. By alkalies it is converted into orcin and carbonic acid. Its solution in ammonia soon takes a reddish purple colour on exposure to the air. Nitrate of silver has no action on an alcoholic solution, but is speedily reduced if boiled with an ammoniacal solution. With perchloride of iron the alcoholic tincture gives a deep purple colour, which is changed into yellow by ammonia. Basic acetate of lead gives a copious precipitate. Erythric acid is considered by Schunck to be the sole basis of the colouring matters extracted from orchella weeds.

Erythrose.—The roots both of common and Turkey rhubarb when digested under certain conditions in nitric acid, yield

from 8 to 10 per cent. of an orange or yellowish matter, which possesses strong tinctorial powers, and to which the names erythrose and erythrosic acid have been given.

With suitable mordants, erythrose is capable of yielding red and violet colours of considerable beauty and value, but like many other colours has been thrown into the shade by the preparations of aniline.

Eschscholzine.—The plant to which the most cacophonous name of *Eschscholtzia* has been given, contains in its root an abundant supply of a colouring matter which may be called eschscholzine. It is capable of dyeing very fine and bright yellow and orange shades. Owing to the superabundance of yellow dyes, it is of no practical value.

Extracting Liquor, Runge's.—A mixture very useful in testing dye-woods, etc.

It is thus prepared:—take 90 parts weight of alcohol or methylated spirit, the stronger the better. Drop into it very slowly, and with constant stirring, 10 parts by weight of oil of vitriol at full strength. Preserve for use in a stoppered phial.

Finishing Blues.—A variety of blue colours are used as a final application to goods which are to be sent out in a white state. After the best conducted bleaching processes all fibres, both animal and vegetable, still retain a faint yellowish tinge, or rather a mixture of yellow and red. The nearest approach to a pure white is obtained by superadding a very faint tint of pure blue. For this purpose a great variety of blue colours have been tried, according to the nature of the goods and the taste of different markets. Prussian blue in its soluble modification has been used, but is apt to give a greenish colour, and when the goods are subsequently washed changes to an offensive rusty shade. The insolubility of ultramarine prevents it being applied with the necessary regularity.

The soluble preparations of indigo, especially purpuric acid and DISTILLED BLUE are better. But certain blue preparations of aniline are now justly preferred to all others from their purity, lustre, and permanence, and the ease with which they may be regularly applied even in the faintest tint.

Flavine.—A yellow and orange colouring matter extracted from quercitron bark. There are two qualities in the market, the American and the English. The former, which is preferable, is prepared by a mechanical process consisting mainly of threshing and sifting. English flavine is a kind of lake or precipitate from the decoction of bark, and contains a variable amount of mineral matter. I have found in some samples of English flavine 8 per cent. of common salt, or as it is significantly called in some establishments the "old useful."

As flavine fluctuates greatly, not merely in strength but in brightness and purity of colour, the best method of examining it is to dye swatches of clean woollen yarn or cloth with the respective samples.

Like many other yellow dyes, flavine has less affinity for vegetable than for animal fibre. Its usual mordants are the preparations of tin, either tin crystals or the liquid known as "nitrate of tin," "bowl spirits," or "scarlet spirits."

Flavine is in very extensive use for yellow and orange shades, as also for giving the yellow part of scarlets and greens.

Fibres, Separation of.—If we suppose a yarn or woven fabric of wool and cotton, they may be separated as follows:—The whole is submitted to the action of steam at a pressure of one and a half to two atmospheres. The wool dissolves out and the residue may be washed, dried and weighed.

Unbleached cotton and linen may be separated thus:—Wash thoroughly in boiling water, and dry. Then lay in a mixture of 2 parts by weight nitrate of potash, and 3 parts sulphuric acid of full strength. Allow it to soak 8 to 10 minutes, then wash it thoroughly, and dry it. It is then immersed in ether mixed with a little alcohol. The cotton dissolves out as collodion, whilst the linen which remains unaffected is washed in boiling water, dried and weighed.

Hemp and flax may be distinguished by moistening with chlorine water, which is poured off after a few minutes, and a few drops of ammonia added. Hemp turns a pale rose colour but flax remains colourless.

Flowers, Colours of.—It is often a matter of surprise with amateur experimentalists why the colouring matters of flowers are so rarely utilized in the tinctorial arts. It must be remembered

that these colours, however bright and beautiful, are for the most part exceedingly fugitive, and are seriously modified, or even destroyed, by exposure to air and light. Next, the colours of flowers are very minute in quantity, and that it would on that account alone be difficult to produce them on a commercial scale. Further, the colour of a flower, and the colour that can be extracted from it, are often quite distinct. Thus the common field poppy gives not a scarlet but a blue extract, of no particular beauty. Processes have indeed been put forward for extracting dyes from flowers. Thus the peony, the dahlia, and the catkins of poplars have been recommended for red colours, and the iris, campanula, and larkspur for blues. So far as the writer is aware these dyes have never appeared in the market and must be looked upon as mere proposals. The only flower at present in actual use for tinctorial purposes is safflower.

At the same time flowers offer to the colourist a number of the most suggestive questions, whose solution would go far to establish a complete system for the production of artificial colours. How, for instance, can the dahlia, the calceolaria, the tulip, the gladiolus be made to vary through a certain range of colour, but no further? Why does yellow, with its modifications, predominate in the flora of the subarctic zone, blue in Alpine regions, whilst red is relatively most abundant within or near the Tropics? How in the case of striped and spotted flowers are different colours elaborated from the same materials, without, as far as we can perceive any speciality of organs for their production? Why is such play of colour sometimes symmetrical, and in other cases totally irregular?

The changes which flowers, leaves, and fruits undergo from prolonged exposure to air and light, are already to some extent intelligible. We find that these changes are in one specific direction, from blue towards yellow. Thus, *e.g.*, the corolla of a fuchsia on the opening of the flower will be of a deep violet, bordering upon blue, but in the course of a few days the colour turns more and more to a red. The leaves of trees, as autumn approaches, pass from green to various shades of brown, in which yellow and red predominate. Similar are the changes in the ripening of fruits, red, orange, and yellow being the final shades. I do not know of an instance in which the change takes the contrary direction. But it is incorrect to say that the movement is from the more refrangible to the less refrangible extremity of the spectrum, since

in the changes of the colours of flowers, yellow does not seem to lie between blue and red, but to be the extreme term reached before decomposition. Something similar is observed in the manufacture of artificial colours. If we employ a very powerful oxidizing agent or too high a temperature we produce yellows or browns.

There are, however, multitudes of flowers where no such changes take place. In the roses, the blossoms of the apple, peach, almond, filbert, bramble, etc., as also in the wood-hyacinth the colour does not change, but simply fades away to near absolute whiteness. And in a third class the colour is permanent. This is chiefly the case with yellow, orange, and scarlet flowers.

A recent investigator refers all the colours of flowers to a few principles, *cyanine*, a blue pigment; a red matter identical with cyanine but altered in colour by acids and two yellow bodies, one of which, *xanthine*, is insoluble in water, and the other, *xantheine*, soluble. Cyanine is non-crystalline, soluble in water and alcohol, but insoluble in ether; it is reddened by acids and turned green by alkalies. This may be true as regards some flowers, but is not universally correct. The red colour of safflower, for instance, is not a blue modified by the action of an acid, since alkalies do not turn it blue even in excess.

Franguline.—(*Rhamnoxanthine*).—A colouring matter obtained from *Rhamnus frangula*, a tree of the same genus as that which yields the Persian berries. The colour is contained in the twigs and in the roots and bark.

When pure, it forms golden yellow crystals, inodorous, tasteless, and nearly insoluble in water, but soluble in alcohol, benzole, and fatty oils. It dissolves in ammonia, potash, and soda, with a splendid reddish purple colour; with alkaline carbonates the colour is less fine.

Concentrated sulphuric acid converts franguline instantly into a beautiful emerald green. To preserve the new colour, the acid must be immediately poured off, when it appears very stable, being unaffected by alkalies and dilute acids. But if the sulphuric acid is allowed to remain in contact with the franguline, the green colour speedily passes into purple and red. On the addition of water, the yellow colour returns.

Deoxidizing agents convert rhamnoxanthine into a brown colour. With the hydrated metallic oxides solutions of franguline

form lakes, some of which are very beautiful. If it be dissolved in dilute ammonia, acidified with citric acid, and magnesia added, a fine violet lake is obtained.

Franguline has a greater affinity for wool and silk, than for cotton. A fine golden yellow may be given to silk by a bath prepared with rhamnus twigs extracted in dilute ammonia, subsequently acidified with citric acid. Reddish and yellowish browns are produced upon wool without any mordant.

By cautiously treating franguline with strong nitric acid, a new colouring matter, *nitrofrangulic acid*, is obtained in orange crystals. It dissolves sparingly in cold, but abundantly in boiling water, forming a crimson liquid, from which it is re-deposited either on cooling, or on the addition of an acid. In alkalies it dissolves with a violet-red colour. The salts of lead, baryta, and lime, give fiery red lakes, with solutions of nitrofrangulic acid. If a prolonged current of the sulphide of hydrogen is passed through a hot aqueous solution of the acid, the dark red liquor changes to a violet blue, which is heightened by the addition of an alkali, and gives a violet blue precipitate with hydrochloric acid.

The composition of franguline approaches closely to that of alizarine.

Fruits, Colours of.—The juices of several fruits exhibit intense and apparently rich colours, chiefly of a purple cast. Such are the mulberry, bilberry, blackberry, and elderberry. These colours, however, when extracted and applied to any kind of fibre, appear very dull, and are exceedingly fugitive. Air and light, as well as soap, acids, etc., rapidly destroy them. Bilberries have been employed upon a small scale for dyeing blueish purples, but are rapidly passing into disuse. The colouring matter of the red cabbage, of the rind of the radish, beet-root, etc., appears similar in its reactions, and is of no value.

Fuchsine, or Fuschine.—One of the red colouring matters obtained from aniline, and generally included, in England, under the common name magenta.

It is, strictly speaking, a hydrochlorate of rosaniline, and is generated when certain anhydrous chlorides, such as those of carbon, elayl, tin, etc., are allowed to act upon aniline at elevated temperatures.

The name which is objectionable, as it would strictly signify

some proximate principle obtained from plants of the genus *Fuchsia*, is still retained in France and Germany.

The colour of fuchsine, properly so-called, is rather of a yellower shade than that of roseine.

Fustic.—(*Cuba Wood, Old Fustic, Yellow Wood.*)—One of the most important dye wares, obtained from *Morus tinctoria*, a large tree growing in Cuba, Nicaragua, and Brazil. The wood is yellow, veined with a more orange shade.

It contains two colouring matters, *morine* (the white morine of Chevreul), and *morein* (identical with the yellow morine of the chemist just named). These colours appear, however, to be modifications of one and the same principle, morine readily passing into morein, when treated with suitable oxidizing agents.

From fustic can be obtained also a fine red colouring matter, the so-called *fustic carmine*, which is worthy of more attention than it has hitherto received.

Morine is found principally in the heart wood. It is soluble in acids, turns a deeper yellow on contact with alkalies, and with solutions of a per-salt of iron turns a vinous red.

Morein, on the contrary, in solution gives a dark green precipitate with the per-salts of iron.

Pure morine is the most delicate test known for ammonia, the smallest trace of which turns it orange. Both morine and morein are apt to take up more oxygen, forming reddish-brown compounds.

Fustic varies less in quality than most dye-wares. It comes into sale in four states; namely, as chips, rasped to powder, as an aqueous extract, and as a paste or lake.

In the two former states it is generally laid up for several weeks before coming into use, being frequently turned over and sprinkled with water. This process softens the woody fibre, and enables the colour to be more easily extracted. Sometimes, however, the water is present in such amount as to constitute an adulteration. I have met with samples both of chipped and rasped fustic, which when carefully dried at 212° Fahr. lost no less than 48 per cent.

Like many other vegetable matters, moist rasped fustic is subject to *heat*, unless frequently turned over. It is not, however, so soon or so seriously deteriorated by such an occurrence as logwood.

Fustic liquor, or extract of fustic, is water saturated at 212° Fahr., with the colouring principles of fustic, and boiled down to 8° or 10° Twaddle. Like the other extracts, this liquor is often *sprung*, as it is technically called, that is, mixed with some substance that may increase its weight, and cause it to mark a higher degree on the hydrometer. Common salt is generally selected from its cheapness, ready solubility, and from the fact that it does not very seriously modify the appearance of the liquid. Some makers of extracts even profess that salt is necessary to dissolve the colouring matter out of the wood. This, I have satisfied myself by direct experiment, is an error. Pure water takes up a larger proportion of the colour, and holds it more perfectly and permanently in solution than saline liquids.

Some of the varieties of paste fustic are simply obtained by evaporating down the liquor. Others are more properly lakes, in which the colour is held in feeble combination with certain mineral bases which readily give it up when required to the fibre. Fustic is very extensively used along with logwood for blacks; woollen and worsted goods are dyed with it a yellow. and a green after previous treatment with extract of indigo. Upon cotton it is also employed for yellows, as well as for greens and some other compound colours, though perhaps less extensively than quercitron bark. It is less affected by acids than quercitron, but has much less tinctorial power.

Young Fustic, Zante Fustic, or Fustet.—The wood of a European shrub, the *Rhus cotinus*, or Venetian sumac. It contains a large amount of *fustin*, a bright but not very permanent yellow colouring matter.

Fustin is soluble in alcohol and water. The solution forms an orange-coloured lake, with preparations of tin, and a dull green, with salts of iron. The solutions of fustin are reddened by alkalies.

Fustet is very little used in cotton-dyeing, not at all in calico-printing. but is used by some woollen-dyers to give a more fiery tint to their scarlets.

Galium.—A plant growing wild in heathy districts, known as bed-straw. It belongs to the madder family, and contains similar colouring matters. An insect which feeds upon it, *Timarcha levigata*, appears saturated with a red colour.

Gall-nuts.—The so-called gall-nuts are not, as commonly supposed, a fruit, but a morbid or diseased growth produced upon the twigs of a dwarf oak, *Quercus infectoria*, when irritated by the eggs of the gall-wasp or gall-fly, *Cynips gallæ tinctoriæ*. The part of the branch where the egg is deposited swells into a round nut-like mass, within which the larva of the insect grows, feeds, and undergoes its metamorphosis.

The galls are of the finest quality when collected just before the insect has made its escape, and are then known in commerce as blue galls. After the insect has emerged the colour is paler, the amount of tannin somewhat less, and they are known as white galls. They are imported chiefly from Asiatic Turkey, those produced in the district of Aleppo being considered the finest. The Chinese galls are also of very good quality. The percentage of tannin in fine galls is about 70 to 78.

The tannin contained in the gall-nut is not only larger in amount than in most other natural sources of this principle, but it is of finer quality, being unaccompanied by colouring matters. Hence they are selected as the best material for the preparation of pure tannin.

The consumption of galls both in printing and dyeing is very limited. They are used in producing the best class of blacks upon silk. When very light and pure shades of aniline colours require to be fixed upon cotton, gall-nuts are selected as the astringent in preference to myrobalans or sumac, as they yield tannin in a whiter state, and consequently furnish a clearer and brighter ground for the superimposed colour.

The amount of gallic acid præ-existing in gall-nuts is very small, but the decoction or infusion, like those of other astringents, is liable to the fermentation which converts tannin into the worthless gallic acid.

Infusions of galls gives with the chloride of manganese a dirty yellow precipitate; with protosulphate of iron a purple tint; with persulphate of iron a blue-black precipitate; with the chloride of zinc a dirty yellow; with the protochloride of tin a straw colour; with perchloride of tin a fawn colour; with chloride of copper a yellow-brown; with nitrate of copper a dull green; with nitrate of lead a faint yellow; with tartar-emetic a straw colour, and with chloride of cobalt a dirty white.

Wild Galls.—An astringent body occasionally used to mix

with myrobalans or divi. Unlike the true gall, they are not a diseased excrescence, but a seed or berry. In form they are somewhat intermediate between galls and myrobalans. When broken, there appears a thin outer layer in which the tannin chiefly resides, and a large hard stone containing a kernel. Neither of the two latter parts have any important per centage of tannin.

The stone forms on an average 50 per cent. of the entire weight of wild galls, and hence the whole nut when ground up is weaker than the myrobalan. The tannin is of good quality,

Gallic Acid.—Exists præ-formed in the seeds of the mango, and is formed in infusions of astringents, such as galls, sumacs, etc., by the decomposition of the tannin, or, as it is sometimes called, tannic acid.

Gallic acid is useless in dyeing blacks. On the other hand, it is actually prejudicial, dissolving the iron mordant, and hindering it from combining with the fibre. Its presence is in great part the cause why extracts of astringents cannot be employed in dyeing after they have turned "sour," as it is called.

Gallic acid with aluminous mordants has been proposed as a red dye, but is not in use.

Garanceux.—Garanceux is a preparation of madder which agrees with garancine in its mode of manufacture, in its general properties, and in the purposes to which it is applied in dyeing and printing.

The distinction is, that whilst garancine is prepared from *fresh* madder, garanceux is made from the spent or exhausted madder collected from the dye-becks. It is weaker than garancine, having when dried one-third the strength, and when damp but pressed only one-sixth to one-ninth.

Garancine.—(*Charbon sulphurique.*)—A very important preparation of madder, taking its name from *garance*, the French word for that ware.

Madder when treated with strong sulphuric acid, is, like most organic matters, blackened, and converted into a species of charcoal. Its colouring matter, however, is not destroyed, and when the acid is removed by washing, the residue is found to have, weight for weight, a greater tinctorial power than the best qualities of unprepared madder.

Madder, during its conversion into garancine, loses from the half to two-thirds of its weight, accordingly as it happens to contain, in addition to colouring matter, more hard woody fibre (lignine) or of soluble principle. On the average, good garancine should be three times as strong as a madder of superior quality.

Garancine is ordinarily of a blackish colour, the depth of which, however, throws no light either upon its quality, or upon the value of the madder from which it was prepared. Further, by a modification of the ordinary process, garancine can be made which does not exhibit this dark colour, but which is not on that account either better or worse than the common kind.

The following is an account of the chief chemical properties of garancine. In pure cold water it is partially soluble, giving, after twenty-four hours' action, a pale yellow solution. Pure boiling water acts more rapidly, yielding a liquid of a more reddish tint. In calcareous, or hard waters, it is less soluble, and in lime-water more slightly still. Water acidulated with sulphuric or hydrochloric acid gives, after some hours' standing, a greenish-yellow liquid. Acetic acid, after some hours' standing, a beautiful orange-coloured solution. Ammonia occasions at once a reddening, and, after twenty-four hours' standing, a liquid of such intense crimson as to be opaque. Very dilute ammonia gives a fine claret colour, and solutions of caustic soda a dark-red of a more brownish hue. Solutions of carbonate of soda quickly give a bright vinous red. Cold alum-water produces very speedily a chrome-red, but if boiling a dark-red, which, on cooling, deposits flakes of the same colour, though rather paler. Alcohol and ether give faint orange solutions.

The uses of garancine are to some extent different in kind, both in printing and dyeing, from those of madder. When used alone in printing they are less permanent, do not stand soap as well, and cannot be brought to the same degree of brightness. The whites at the same time are clearer and purer. It serves for blacks, reds, and purples, and especially for chocolates. It is much better adapted than madder for using along with other colouring matters, such as the dye-woods, quercitron bark, and especially catechu and sumac. With these additions it gives a variety of brown, drab, grey, chocolate, and orange shades.

Gardenia Pods.—These pods, sometimes known as Chinese yellow pods, contain a yellow colouring matter named by Rochle-

der, its discoverer, *crocine*. This colour, when in a state of purity, forms a bright powder, easily soluble in water and alcohol. With salts of lead, it forms orange-coloured lakes. The concentrated solution in water, if mixed with undiluted sulphuric acid, becomes indigo-blue, and then violet. If heated with dilute sulphuric, or muriatic acid, it is decomposed, yielding *crocetine* as a fine dark red amorphous powder, sparingly soluble in water, but readily in alcohol. With undiluted sulphuric acid, it gives the same blue colour as crocine. Crocetine is a true dye. It gives on tissues mordanted with salts of tin, a dingy greenish yellow, but when passed through water containing a little ammonia, it is changed to a bright golden yellow, permanent on exposure to air and light, and unaffected by soap. It appears to be identical with the colouring-matter of the common yellow crocus, and with polychroite, the colour of the saffron.

Other species of *gardenia* possess tinctorial properties. *G. aculeala*, a native of Jamaica, gives a fine and permanent blue colour, but has not been brought into use.

Gelatin.—A highly nitrogenous organic matter, obtained by the action of boiling water or steam upon the so-called gelatigenous tissues of animals. It is supposed not to præ-exist in such tissues, but to be a product of transformation. Two distinct, though closely allied substances are comprehended under the name: gelatin, properly so-called, and chondrine. The former is obtained from hoofs, horns, hides, and bones; the latter is produced from the cartilages of the ribs, nose, windpipe, etc. The chief chemical distinction between the two is that gelatine is precipitated by tannin, whilst chondrine is not.

Gelatine, when pure, is colourless, tasteless, inodorous, soluble in boiling water, but insoluble in cold, though it swells up and softens. In alcohol it is insoluble. Sulphuric acid, when concentrated, converts gelatine into sugar of gelatine and leucine. Hot nitric acid converts it into oxalic acid. By strong acetic acid it is dissolved, without injury to its adhesive property; by weak nitric acid, it is converted into "soluble glue," which dissolves in cold water.

Gelatine contains, when in a dry state, 18 per cent. of nitrogen.

The purer forms of gelatine have been used for animalizing cotton, and as a mordant for certain colours upon woollen tissues.

For such purposes the colourless kinds should be selected. To fix gelatine upon the fibre, solutions of tannin are generally applied, either before or after the colour with which it forms an insoluble combination.

For other applications of gelatine see SIZE.

Geranium Red.—(*Iodide of Mercury.*)—A magnificent scarlet pigment which has been proposed for use in printing. Although more beautiful than vermilion, its great density and liability to decomposition when exposed to light in contact with organic matter, render it practically almost useless. It is sometimes applied in printing as a pigment-colour, but all attempts to produce it in the fibre by mordanting with one of its constituents and applying the other, have failed.

Glycerine.—The sweet principle of oils and fats, is a secondary product obtained in the soap manufacture and in the preparation of stearine.

When pure it is a faintly yellowish liquid, of an intensely sweet taste, and of specific gravity 1·26 or 52° Twaddle. It mixes with water and alcohol in all proportions. It dissolves a great number of salts and organic bodies. As it is not volatile, these solutions are not subject to dry up, or allow their solid constituents to crystallize out—a circumstance upon which many of the uses of glycerine depends.

Good glycerine should leave nothing behind if exposed to a red heat. If mixed with water and boiled with solution of caustic soda or potash, it should not be altered in colour. If this takes place the sample is adulterated with starch-sugar. If mixed with an equal measure of alcohol, to which 1 per cent. of sulphuric acid has previously been added, it should not give any deposit, even after long standing.

Some qualities, otherwise correct, have a slightly empyreumatic taste and smell. This, for the purposes of the dyer and printer, is no drawback.

One of the main uses of glycerine is, that, used in dissolving certain aniline colours, it prevents their tendency to bronze the surface of the goods, and enables them to yield brighter and softer shades than if dissolved in methylated spirit alone.

Greens, Detection of, on Fabrics.—The ordinary greens

are compounds of a blue and a yellow. Their components are so various that no fixed rules can be laid down for their treatment. It is advisable to place a bit in a solution of carbonate of soda, and note whether a blue colour is dissolved out. If so, it will be extract of indigo. If instead of colouring the liquid blue, the bit is turned a rusty colour by carbonate of soda and caustic soda, Prussian blue is present, which is very frequent on cottons. If sulphuretted hydrogen blackens the green, chrome yellow is one constituent. This, of course, is confined to cottons. On wool and worsted stuffs if extract of indigo is dissolved off, the yellow part will probably be fustic. If the blue be a Prussian, the yellow will generally be quercitron bark.

If the green cannot be resolved into a blue and a yellow part, it will probably be an aniline green. If so, it will be unaffected by hydrochloric acid diluted with three times its bulk of water. By the strongest hydrochloric acid it will be stripped in fifteen minutes, the liquid being yellow.

Gum Arabic.—The gums are a class of vegetable bodies possessing no very marked chemical properties, and holding a kind of intermediate place between the starches and the sugars. From the former they are distinguished by their solubility and by the circumstance that they are not coloured when brought in contact with iodine. From sugars they are distinguished by their inability to enter into true fermentation with production of carbonic acid and alcohol. Unlike the starches and sugars they are also incapable of digestion, and when introduced into the animal system are excreted unchanged.

They are insoluble in alcohol, and are precipitated by it from their watery solutions in the state of a white powder, a fact which distinguishes them from the so-called gum-resins.

Gum arabic may be regarded as the type of the class. It is obtained from several species of *Acacia*, growing in Arabia and Northern Africa, especially *A. Arabica*.

It occurs in irregular rounded pieces which are brittle, hard, semi-transparent, and either colourless or slightly tinged with yellow. It is without smell and almost tasteless; rapidly soluble in hot and more slowly in cold water. Its specific gravity ranges from 1·31 to 1·5. When apparently dry it still retains 17 per cent. of water, which may be expelled by prolonged exposure to 212° Fahr. in the state of powder.

It is adulterated with picked gum senegal, which scarcely differs from it in its properties.

When sold, as sometimes, in the form of powder, it is occasionally mixed with starch or flour. These frauds are readily detected by the addition of a drop of tincture of iodine, which gives a blackish blue colour if they are present.

Gum arabic is very rarely used in printing or finishing, from its high price.

Gum Mezgnite.—(*Muckeet, Mezgneet, and Musgneet.*)—The produce of an unknown tree growing in Western Texas and New Mexico. Occurs in irregular pieces and balls, and tears, semi-transparent, and varying in colour from a deep amber to a pale yellowish white. It is very easily powdered. Its composition agrees very closely with that of gums arabic and senegal, consisting mainly of arabin with traces of bassorin. Cerasin is not present. It is insoluble in alcohol, readily soluble in water, forming an adhesive mucilage. It will probably be found a safe and economical substitute for gum senegal and the inferior qualities of arabic.

Gum Senegal.—This gum is produced by *A. senegalensis*, and differs from gum arabic chiefly by its darker colour and larger amount of impurities, such as sand, earth, fragments of wood, etc. It is more liable to turn sour than gum arabic when in the state of solution.

Still inferior varieties are met with under the name of Turkey gum, Indian gum, etc. These vary greatly in quality, some samples being very little inferior to average gum senegal, whilst others can scarcely be called truly soluble in water, as they form ropy masses instead of yielding a smooth, uniform mucilage. The quality of such gums may best be judged by dissolving a small portion in warm water, and noting the texture and adhesiveness of the solution.

Cherry gum is never offered in the market under its own name, but is frequently used to sophisticate more valuable kinds. It is generally found in irregular brown lumps, which are hard to break. In water it forms clotty lumps and dissolves very slowly and imperfectly. Like tragacanth it gives with solution of the subacetate of lead not a white curdy precipitate, but a transparent jelly.

Gum Tragacanth.—This gum is the produce of *Astragalus creticus*, and is found in irregular flat pieces, threads, and lumps, white or yellowish in colour, opaque, scentless and tasteless. In boiling water it is entirely soluble, but in cold water it dissolves imperfectly.

One pound forms as tenacious a liquid with an equal bulk of water, as 25 lbs. of gum arabic. Its use is, however, greatly limited by its scarcity and consequent high price. The solution of tragacanth in water is only rendered very imperfectly turbid by the addition of alcohol, in which respect it differs from the true or normal gums.

When sold in lumps it is rarely adulterated, but in the state of powder it is often mixed with gum senegal. This admixture not merely dilutes the tragacanth but positively injures it. It may be detected by dissolving a portion of the suspected sample in hot water, and adding, under constant stirring, a few drops of the tincture of guiacum. If gum arabic or senegal be present, even in so small a quantity as 5 per cent, a blue colour will appear.

The subjoined table will be found useful in discriminating the various kinds of gums :—

Gums.	*Sulphate of Iron.*	*Tincture of Guiacum.*	*Subacetate of Lead.*
Gum Arabic	Yellow precipitate	Blue colour	White curd
Senegal	Ditto	Blue colour	White curd
Cherry	Ditto	Blue colour	Transparent jelly
Tragacanth	Ditto	No change	Transparent jelly
Dextrine	No precipitate.		

Yellow Gum.—(*Botany Bay Resin.*)—This substance is produced by an Australian tree, named *Xanthorrhoea hastilis*. It is

not a gum but a gum-resin, being insoluble in water and soluble in alcohol. It is found in reddish brown irregular masses, partially semi-transparent and lustrous, and in parts dull and earthy, and often bearing impressions of the bark of the tree. It is used in making varnishes, and was till lately, the best material for the manufacture of picric acid, but is now quite superseded for this purpose by carbolic acid.

Gutta Percha.—This gum-resin has been much used in chemical, print and dye works for pipes, syphons, jugs, etc., for cold liquids. It is commonly said to be proof against all alkalies and acids except concentrated oil of vitriol. It is perfectly true that when immersed in any of these liquids no immediate corrosion or other action is manifest. Yet if a gutta percha jug is regularly used for nitric or muriatic acid, solutions of tin, iron, or alumina, it becomes brittle, cracks in various directions and is rendered quite useless. It is worthy of remark that in this state it cannot be repaired. If the cracked and damaged parts are gently warmed and pressed together, they refuse to cohere. Thus the properties of the gutta percha appear entirely altered.

This want of permanence, coupled with its inability to resist heat and its high price, has caused gutta percha to be disused in many establishments.

Gypsum.—(*Plaster of Paris, Sulphate of Lime.*)—A white, or yellowish-white mineral extensively found near Newark and in some parts of Derbyshire. It is composed of 28 parts of lime united with 40 of sulphuric acid and 18 of water. Below a red heat it loses all its water and crumbles to a powder. If this operation is performed at about 260° Fahr. it sets again into a solid mass if wetted, but if roasted at 400° Fahr. it refuses to take up the water. It dissolves in about 400 times its weight of water.

Gypsum is one of the hardening ingredients present in many natural waters, and has an unfavourable effect upon dyeing and printing operations.

It was at one time much used for weighting cotton goods, but is now chiefly abandoned in favour of the sulphate of baryta, which is heavier.

Its chief abuse, as far as the tinctorial arts are concerned, is

in the adulteration of pigment colours, which it renders dull, harsh, and chalky.

Hemlock Bark.—The bark of the hemlock spruce, *Abies canadensis*, a kind of fir tree very plentiful in Nova Scotia, New Brunswick, and the north eastern states of the American Union.

It is, like sumac, etc., an astringent, and has been slightly used for dyeing purposes with unsatisfactory results, as it gives a rusty or "foxy" surface reflexion to the goods.

Hollyhock.—A well-known ornamental plant of the mallow tribe. It was at one time alleged to contain a blue colouring matter very similar to indigo, but no one appears to have obtained this colour to any extent beyond mere traces, and it certainly has never found its way into the market.

Hydrochloric Acid, known also as *Chlorhydric Acid, Muriatic Acid, and Spirits of Salts.*

This acid is a compound of hydrogen and chlorine, and is, strictly speaking, gaseous; the liquids commonly used and sold under the name being water saturated with the gaseous acid.

When pure and concentrated the liquid acid is a clear colourless liquid, of the specific gravity of 1·21 or 42° Tw. As commonly met with in commerce it has the specific gravity 32° to 34° Twaddle, and is of a yellowish colour. It often contains a variety of impurities. The principal are sulphuric acid, which may be added purposely to raise the specific gravity, or may be introduced by negligence in the manufacture. It may be detected by adding distilled water and afterwards a solution of the chloride of barium, when a white precipitate shows the presence of sulphuric acid.

Common salt is sometimes added to raise the specific gravity of a weak acid. It is scarcely needful to say that though it raises the hydrometer it adds nothing to the real strength. This fraud is very readily detected by putting a little of the suspected acid in a saucer and evaporating it down at a steam heat, when the salt or other analogous matter will remain and may be weighed.

Sulphurous acid, and probably other lower oxides of sulphur, may result from decomposition of the sulphuric acid used in the manufacture. It may be detected by putting into the suspected

acid a few particles of granulated tin. If sulphurous acid be present, the offensive odour of sulphuretted hydrogen will be perceptible, and the liquid instead of remaining clear will become yellowish and turbid.

Iron is generally present in commercial hydrochloric acid, to which it imparts a pale yellow colour, which disappears on adding a proto-salt of tin. This impurity is rarely, if ever, present in quantity sufficient to interfere with the uses of the acid.

The best hydrochloric acid is prepared by acting upon common salt with sulphuric acid in iron cylinders, and condensing the acid vapour in receivers containing water. This kind is known as "cylinder-salts," and should always be selected for preparing mordants or other uses connected with dyeing and printing.

The other kind is obtained as a secondary product at alkali-works, where salt is decomposed by sulphuric acid prepared from pyrites. The operation takes place in open iron pans, and the fumes are drawn into a tower filled with coke, over which water trickles. This acid is known as tower-salts, and is sometimes sold at the strength of 31° or 32° Tw., for one farthing per lb. It is not to be relied on, yielding good results only occasionally. The tin-mordants made with it appear to have a remarkable power of corroding the fabrics to which they are applied. For liberating chlorine with the black oxide of manganese, "tower-salts" are well adapted. Dyers and manufacturing chemists are strongly recommended not to use them in the preparation of mordants or "spirits," as the saving of, perhaps, a farthing per pound will poorly compensate for uncertain, fluctuating results, and for the occasional destruction of a dyeing of valuable wool or cloth.

Muriatic acid is more indirectly than directly used in print and dye-works. It is of importance as a solvent for tin, and to a much smaller extent for iron. Whatever metallic oxide it holds in solution, it is more disposed to work upon wool than upon cotton. Upon animal and vegetable fibre its action is destructive, though much less rapidly than oil of vitriol. It is frequently used by dyers, either alone or mixed with oxalic acid, for taking out rust-spots, and has no prejudicial action if washed perfectly away as soon as the iron stain is removed. If a trace of it is allowed to remain, the cloth will become tendered.

Bottles containing spirits of salts should never be allowed to stand unstoppered, as their effective strength is not only thus

wasted, but damage may be done by the fumes, which frequently strip off iron mordants in streaks and patches from dyed or partly dyed goods which have been exposed to their influence, especially if in a moist state.

Hydrometer.—An instrument for readily obtaining, in an approximate manner, the comparative weight, or, as it is technically called, the specific gravity of liquids.

Hydrometers vary much in their scale or graduation, and serious mistakes are sometimes made by confounding the degrees of different instruments. Those mostly in use in this country are the direct scale and Twaddle's. The former takes water to be = 1, or 1·000, and shows at once the weight per gallon of the liquid; the two first figures from the left hand being pounds, and the next two or more proceeding to the right being decimal fractions of a pound. Thus water has on this instrument the mark 1, or 1·000, and its weight per gallon is 10 lbs. Double oil of vitriol marks 1·849°, and a gallon of it weighs 18·49 lbs., or very nearly 18½ lbs.

Some instruments graduated on the same principle have the first figure on the scale omitted; thus on them double oil of vitriol marks 849°, and water, instead of 10°, marks merely 0°. Such instruments are often to be met with at alkali works.

The scale most commonly used in dye and print works is that of Twaddle or Twaddell, so called from the original maker. This instrument puts water = 0°, and the very strongest oil of vitriol = 170°. These degrees are arranged on a series of six instruments, numbered progressively from the lightest upwards. It does not embrace liquids lighter than water.

Twaddle's scale and direct specific gravity are easily converted into each other. If the weight of a liquid has been taken with Twaddle, to find its direct specific gravity multiply by 5, and add 1·000 to the product. Thus a sample of aqua-fortis marks 32° Twaddle—

32
5

160
1·000

1·160, the direct specific gravity of the same.

On the other hand, the specific gravity being known by experiment, to find the degree of Twaddle, subtract 1·000, and divide the remainder by 5. Thus a sample of sulphuric acid marks—

1·849
1·000

5) 849

169, the degree of Twaddle.

On the continent of Europe the most common scales are those of Beaume, of Beck, and of Cartier, the latter only for liquids lighter than water. None of these bear any very definite relation either to direct specific gravity, or to Twaddle. The following tables will make any receipts intelligible in which these scales are used.

1. Table for comparing Beaume with direct specific gravity.

a. Liquids heavier than water.

0 = 1·000	39 = 1·373
3 = 1·020	42 = 1·414
6 = 1·040	45 = 1·455
9 = 1·064	48 = 1·500
12 = 1·089	51 = 1·547
15 = 1·114	54 = 1·594
18 = 1·140	57 = 1·659
21 = 1·170	60 = 1·717
24 = 1·200	63 = 1·779
27 = 1·230	66 = 1·848
30 = 1·261	69 = 1·920
33 = 1·295	72 = 2·000
36 = 1·333	

b. Liquids lighter than water.

10 = 1·000	18 = ·942
11 = ·990	19 = ·935
12 = ·985	20 = ·928
13 = ·977	21 = ·922
14 = ·970	22 = ·915
15 = ·963	23 = ·909
16 = ·955	24 = ·903
17 = ·949	25 = ·897

26 = ·892	34 = ·847
27 = ·886	35 = ·842
28 = ·880	36 = ·837
29 = ·874	37 = ·832
30 = ·867	38 = ·827
31 = ·861	39 = ·822
32 = ·856	40 = ·817
33 = ·852	

2. Table for comparing direct specific gravity with Beck.

Liquids heavier than water.

1 = 1·0059	32 = 1·2319
2 = 1·0119	33 = 1·2409
3 = 1·0180	34 = 1·2500
4 = 1·0241	35 = 1·2593
5 = 1·0303	36 = 1·2687
6 = 1·0366	37 = 1·2782
7 = 1·0429	38 = 1·2879
8 = 1·0494	39 = 1·2977
9 = 1·0559	40 = 1·3077
10 = 1·0625	41 = 1·3178
11 = 1·0692	42 = 1·3281
12 = 1·0759	43 = 1·3386
13 = 1·0828	44 = 1·3492
14 = 1·0897	45 = 1·3600
15 = 1·0968	46 = 1·3710
16 = 1·1039	47 = 1·3821
17 = 1·1111	48 = 1·3934
18 = 1·1184	49 = 1·4050
19 = 1·1258	50 = 1·4167
20 = 1·1333	51 = 1·4286
21 = 1·1409	52 = 1·4407
22 = 1·1486	53 = 1·4530
23 = 1·1565	54 = 1·4655
24 = 1·1644	55 = 1·4783
25 = 1·1724	56 = 1·4912
26 = 1·1806	57 = 1·5044
27 = 1·1888	58 = 1·5179
28 = 1·1972	59 = 1·5315
29 = 1·2057	60 = 1·5454
30 = 1·2143	61 = 1·5596
31 = 1·2230	62 = 1·5741

63 = 1·5888	67 = 1·6505
64 = 1·6038	68 = 1·6667
65 = 1·6190	69 = 1·6832
66 = 1·6346	70 = 1·7000

Table for comparing Cartier with direct specific gravity.

Liquids lighter than water.

10 = 1·000	28 = ·879
11 = ·992	29 = ·872
12 = ·985	30 = ·867
13 = ·977	31 = ·862
14 = ·970	32 = ·856
15 = ·963	33 = ·851
16 = ·956	34 = ·845
17 = ·949	35 = ·840
18 = ·942	36 = ·835
19 = ·935	37 = ·830
20 = ·929	38 = ·825
21 = ·922	39 = ·819
22 = ·916	40 = ·814
23 = ·909	41 = ·809
24 = ·903	42 = ·804
25 = ·897	43 = ·799
26 = ·891	44 = ·794
27 = ·885	

The hydrometer, of what make soever, should never be used to hot liquids. These are, of course, expanded by the temperature, and will mark several degrees lighter than their true standard. Hydrometers, further, are useless for glutinous liquids, such as solutions of size, gum, starch, etc.; they are also inapplicable to liquids in which solid matter is held in suspension, as well as to such as are giving off gases.

It should be remembered that the hydrometer shows merely the specific gravity of a liquid, without indicating by what substances that specific gravity is caused. Hence, if we find a sample of a liquid mordant, etc., marking a higher Twaddle than others, we must not consider this a proof of its superiority except we know that no impurity or adulteration is present. A genuine "double muriate" of tin at 90° Tw., may be worth more than one at 125° Tw., but got up with chloride of zinc. A sample of bark

liquor standing honestly at 8° Tw., is certainly better than one originally of the same strength, but "sprung" to 10° Tw. with salt. The erroneous notion that the hydrometer is a test of quality is encouraged by certain manufacturing chemists who when travelling for orders invariably carry a Twaddle, or "gauge," as they call it, with them. If they can show that their samples—perhaps by dint of adulteration—mark higher than those of some other manufacturer, they claim this as an indisputable proof of superiority, and too often the claim is at once allowed by ignorant consumers.

The ammonia-meter, or hydrometer for ammonia, commonly used in this country very nearly agrees with Beaume's scale for liquids lighter than water. It is generally divided into 45°, of which 0° corresponds with 10° on Beaume's light glass, and represents water; the higher the degree the lower being the specific gravity.

Imperial Purple.—(*French Purple.*)—This is a preparation of the colouring matter of orchella weed, faster than archil and cudbear, and produced by the action of lime water.

Its use in dyeing being somewhat complicated, it is almost entirely superseded by the aniline violets, which produce superior shades with more facility.

Indigo.—A well-known blue dye, obtained from several plants of warm climates belonging to the genus *Indigofera.* In the plant it exists as a yellowish liquid, but when extracted and exposed to the action of the air it becomes insoluble, and takes an intense blue colour. The cultivation of indigo is chiefly carried on in India, Bengal being usually the finest in quality. Smaller quantities are obtained from Java, Egypt, Senegal, Guatemala, Brazil, Louisiana, and Madagascar.

The indigo of commerce contains the true blue colouring matter, indigotine, in proportions ranging from 10 to nearly 80 per cent., and averaging about 50. Besides indigotine, the indigo of commerce contains mineral impurities, gluten, which can be dissolved out by dilute acids, indigo-brown, soluble in alkalies, and indigo-red, soluble in alcohol. The blue colouring matter can be dissolved in strong oil of vitriol, but although the colour of the solution is blue its nature is entirely altered. As such, indigotine cannot be considered to be soluble at all. It is destroyed by aqua-fortis and by chlorine, and solutions of bleaching liquor. By

dilute sulphuric acid, by muriatic acid and dilute alkalies, it is entirely unaffected. At a high temperature it is volatilized, and condenses as a purple powder upon any cold surface. By a mixture of alkalies and reducing agents indigo can be dissolved, being brought back to the state in which it existed in the sap of the plant. Upon this reaction indigo-blue dyeing depends.

Indigo occurs in the market in lumps, which if good are of a deep purple-blue colour, and exhibit a fine reddish coppery lustre if rubbed with a hard polished body. If very hard or heavy the indigo is bad, as also when the colour is dull, blackish, greenish, brownish, or slate colour. If broken, the fracture should be fine-grained, uniform, and compact. It should not exhibit shining particles when held up to the light, nor should there be any appearance of layers or strata of different shades. Black spots are also objectionable. White or pale greyish spots do not necessarily indicate a bad quality. .

The value of a sample of indigo is generally in close relation to its specific gravity, the lighter the better. This may be determined as follows in a manner sufficiently accurate for all practical purposes. With a rasp take off a few grains from each fragment or lump in the sample. Mix them well, grind to a fine and uniform powder. Introduce this into a Rham's specific gravity bottle, which must be filled quite full by tapping and shaking. It is then weighed and the tare of the bottle being deducted, the nett weight will give very closely the relative value of the sample. We may safely say that even if in some rare cases a light indigo may be bad, a heavy sample cannot be good. The weights will be found to vary as much as 40 per cent.

This process may easily be supplemented and checked by the following simple colour test: Take 5 grs. of each sample in fine powder—a portion of that used for the specific gravity test will be suitable—and put it in a two-ounce flask, which must be perfectly dry. Add to it an equal bulk of quartz sand, which must have been previously digested in *aqua-regia*, washed in abundance of pure water, and made perfectly dry. Pour upon each 4 fluid drachms of the strongest sulphuric acid, stopper the flasks, and let them stand 24 hours at about 80° Fahr. Then pour out the contents of each flask into a quart or litre measuring glass, rinse out the flask with clean water as long as any colour remains, pour the rinsings into the measure and fill up with water to a fixed mark. Stir till the blue solution is of an equal strength through-

out. Now take of this liquid 2 fluid drachms, and pour them into a 2 oz. phial of clear white glass; fill up with water, mix perfectly by closing the bottle with the finger, and inverting it two or three times, and then place it in a north light. The remaining samples are treated similarly and then compared for depth and purity of colour.

If it is desired to ascertain the amount of moisture in a sample of indigo, 200 grs. in fine powder may be weighed out and exposed to 212° Fahr. for three or four hours. When reweighed, the loss will show the amount of moisture. It should not exceed 5 per cent.

The amount of ash may be determined, if needful, by weighing out 50 grs., placing them in a platinum crucible or capsule, and igniting till the residue of ash is perfectly white. It must be remembered that the incineration of indigo is a tedious process and requires much care. The ash should not exceed 6 or 7 per cent.

There are several volumetric methods of determining the amount of real indigo-blue in a sample, of which the most reliable is here given: 10 grains of the sample in very fine powder is introduced into a stoppered 3 or 4 oz. flask, and therein well mixed with about an equal bulk of very coarsely-pounded quartz or rock crystal, clean and perfectly dry; 100 grain measures of fuming sulphuric acid are added, the flask is stoppered and the whole mixed together by careful shaking. The flask is then exposed to the heat of 80° Fahr. for eight or ten hours, being occasionally shaken. The liquid is then poured into a large graduated jar, every trace of colour is rinsed out of the flask, the rinsings are added, and sufficient water to make up 10,000 grain measures. This is well mixed, so that all portions may be exactly alike. One-tenth of the liquid is now accurately taken out by means of a pipette, and placed in a suitable white porcelain basin, or beaker glass, the liquid is next diluted with three or four times its bulk of water, and a standard solution of permanganate of potash is carefully dropped in with the pourette till all the blue and even green colour disappears and a dingy yellow remains. The number of degrees required, multiplied by 10, will give the relative strength of each sample. A similar experiment performed upon pure indigo-blue will convert the merely relative value into a positive determination.

Extract of Indigo.—(Known also as *Soluble Indigo, Saxony*

Blue, Sulphate of Indigo, Sulphindigotic Acid, and *Sulphindylic Acid,* etc.)—Consists of indigo-blue in as pure a state as can be conveniently obtained, rendered soluble by means of the strongest oil of vitriol; or, better, of fuming sulphuric acid. A portion of the acid is afterwards, in most cases, neutralized and removed.

Ordinary paste extract should form a tolerably consistent, semi-fluid mass of a purple colour, without any greenish reflexion.

It should dissolve in water readily and completely, without any sediment, or any floating solid particles, and forming a bright blue liquid, which when seen by artificial transmitted light appears red.

If the indigo has not been perfectly freed from the green and brown colouring matters, the extract will have a greenish or olive shade, and any goods dyed with it will be deficient in bloom. If any portion of the indigo has escaped being perfectly dissolved the extract will exhibit floating flakes and specks when mixed with water, and articles dyed with it will probably be spotted.

The solution of the extract in water is bleached by prolonged exposure to air and light. By nitric acid it is turned yellow, and by an excess of ammonia it is first turned greenish and then destroyed.

An extract of indigo made with excess of acid, none of which is afterwards neutralized or removed, is called "chemic," "chemic blue," or "sour extract," in contradistinction to the paste, or "sweet extract," just described. It is, of course, a liquid, and is intensely sour. It is usually made from refined indigo, otherwise it cannot be freed from the green and brown colours.

Extract of indigo in which the acid is perfectly neutralized is called "indigo-carmine," "soluble indigo," or "free extract." This, of course, is not a paste but a dry powder, and may be at once distinguished from ordinary indigo, whether crude or refined, by its solubility in pure water.

The more acid varieties of extract are used for dyeing woollens and worsteds, whilst the "sweet," or neutral kinds, serve for cotton and silk.

To determine the quality of a sample of extract, a certain weight of wool or worsted is boiled for a determinate time, along with a known weight of the extract. This process shows both the strength and the purity of the colour in comparison with other samples, and the pattern thus obtained may be preserved for reference.

See also methods of testing indigo.

Blues dyed with extract of indigo can generally be stripped or discharged by means of carbonate of soda or ammonia. They are faster the more acid the extract employed. By a particular process, however, they may be made very fast upon wool, and are then known as "navy blues." These are distinguished from vat blues by the circumstance that they do not soil a white silk handkerchief, and that they are more readily discharged by nitric acid.

Extract of indigo, like indigo itself, may be rendered colourless by reducing agents. Thus, if fragments of zinc are placed in a solution of the extract, the blue colour is soon destroyed. On prolonged exposure to the air, however, it returns.

There is no means known, however, of regenerating indigo from its compounds with sulphuric acid.

Indigo, Red Extract of.—Besides the "red extract of indigo," more properly called purpuric acid, there is a totally different preparation to which the same name is applied.

It is obtained by the action of concentrated solutions of caustic alkali (hydrates of potash or of soda), upon indigo carmine. The exact nature of the process, and the circumstances upon which its success depends are by no means thoroughly understood.

The colour produced dyes upon wool lilacs, flesh-colours, vinous reds, and a kind of purple. All these shades are exceedingly fast, resisting all reagents which do not destroy the fibre itself. They are unfortunately, however, dull and rather meagre, and being at the same time expensive—as a part of the indigo is destroyed in the process—they are not in use.

This is, however, a subject worthy of careful experimental attention.

Indigo, Refined.—This article professes to be indigo-blue or indigotine freed or nearly so from the impurities, mineral or organic always present in crude indigo. It should not effervesce with acids. If a small quantity is digested in hydrochloric acid, and another in a strong solution of carbonate of soda, neither should colour the liquid green, yellow, or brown. If burned to ashes a mere trace of mineral matter should remain. I have met with refined indigoes—so-called—which contained 13 to 15 per cent. of mineral matter.

Refined indigo is used for producing the finest quality of chemic blue.

Iodine.—A non-metallic elementary body bearing in many points a close analogy to chlorine, and like it capable of bleaching vegetable fibre. Its use in the preparation of the finest aniline violets has rendered it of great importance to the tinctorial chemist. It is, when solid, a body resembling black lead, with which it is at times adulterated, but when heated it is converted into a splendid violet-coloured vapour of a most irritating odour.

Its chief commercial source is the ash of incinerated sea-weeds though it is also found in a mineral form in combination with lead and silver.

Iron, Muriate.—A proto-chloride of iron, formed by saturating commercial muriatic acid with iron scraps or borings, is used under this name to a limited extent. It is very prone to take up oxygen from the air and undergo decomposition, and should therefore be preserved in well-closed carboys. Its strength is generally about 80° Tw., but by concentration can be converted into pale-greenish crystals which should be kept as much as possible from contact with the air, and are for some purposes preferred to the liquid.

The per-chloride of iron, made by acting upon the metal with a mixture of nitric and muriatic acids is scarcely ever used.

Iron, Persulphate.—This is a salt which differs from copperas in containing its iron in the state of a peroxide instead of a protoxide. It is an ingredient in all varieties of nitrate of iron prepared from copperas, the proto-sulphate of iron being always to a great extent peroxidized by the nitric acid employed. A persulphate of iron containing very little nitrate occurs in the market under various names, and is preferred for some purposes to the nitrate.

Iron, Sulphuret of.—A compound of iron and sulphur, found naturally, occurring under the name of iron pyrites. It has no direct application in dyeing, printing, or bleaching, but is used in the manufacture of copperas and sulphuric acid.

The name sulphuret of iron is improperly given by some drysalters to dried or roasted copperas, a mixture of copperas freed from its water of crystallization with some persulphate of iron and insoluble peroxide of iron.

Isopurpuric Acid.—A substance isomeric with murexide and produced by the action of cyanide of potassium upon picric

acid. It dyes wool and silk splendid violet shades but it has the inconvenience of being fearfully explosive except kept constantly moist. This circumstance has very much limited its applications.

Jute.—A vegetable fibre now often mixed with cotton. Its affinities for colouring matters and mordants resemble in kind those of cotton but are decidedly feebler. Piece-goods, whose warp is partly jute, occasion on this account great annoyance to the dyer, and the shades obtained are never equal to those produced with similar materials upon cotton.

Kelp.—The ash obtained by incinerating the sea-weeds on the British coasts. It is weaker in alkali than soda-ash, and even than barilla, and is now never used in scouring wool, etc., but is employed by alkali manufacturers to mix off strong soda-ash.

Kino.—A gum-resin obtained from Australia and India, the former kind being yielded by *Eucalyptus resinifera* and the latter by *Pterocarpus erinaceus.*

Kino is red in small fragments but appears almost black in large masses. It dissolves both in water and in alcohol with a red colour, but the aqueous solution does not long remain clear.

It is exceedingly rich in tannin of the same kind as that which occurs in catechu, but its high price, and the intensity of the colour accompanying the tannin prevent it from coming into use as an astringent.

From the matter which is deposited on allowing a decoction of kino to grow cold, a fine red colouring matter has been prepared which might attract more notice were it not for the superior beauty of the red and violet colours obtained from aniline.

Lac (Lac Dye and Lac Lake).—A red colouring matter of the same class as cochineal. Lac in its original state (called also stick-lac) consists of small parasitical insects—*Coccus ficus*—cemented together by a resinous matter exuding from the twigs of the trees which they inhabit, namely, *Ficus indica, Rhamnus jujuba, Croton lacciferum,* and *Butea frondosa,* natives of various districts in India. The colouring matter is dissolved out of the stick-lac, and dried into small cakes about 2 or 2½ inches square, and about half-an-inch thick. These are the so-called lac-dye, and contain

about 50 per cent. of colour, accompanied by alumina and other earthy matters, and by variable amounts of resin.

Lacs vary very much in quality, some being worth more than double others. A good lac should be so soft as to be broken by the fingers without much difficulty. The fracture should show a deep colour, but not have a shining resinous appearance, and should give out a strong peculiar odour. If it be very hard, with a resinous fracture, it contains a large amount of shellac, and a proportinately small percentage of colour. Under the pestle lac should be easily reduced to powder.

Lacs may be easily subjected to tests for colour. Five grains, well powdered, are placed in a phial, each sample covered with an equal measure, say two fluid drachms, of scarlet finishing spirit, and set aside for an hour. At the expiration of that time, about an ounce of water is added to each, and the tubes or phials are exposed for another hour to a moderate heat. They are then compared as regards depth of colour.

Samples of lac may also be extracted with a weak alkaline liquid, and tested with red prussiate of potash as directed for cochineal. If the lacs are intended for printing, or for dyeing wool and woollen cloth, no further investigation is needful; but if they are wanted for dyeing worsted goods which have to be hot-pressed, it is necessary to ascertain how much resin it contains. If loaded with matter of this kind, the pressing-paper will stick to it in patches, spoiling the goods. For this purpose, equal weights of the samples in powder are placed in small flasks, equal measures of alcohol are added, and they are exposed loosely stoppered, to a gentle heat. The alcoholic solutions are then decanted off into light capsules, which have been previously carefully tared, evaporated to dryness, and weighed. The net weight will be the amount of resinous matter—shellac—present in each sample.

The colouring matter of lac is very similar to that of cochineal. It is turned by ammonia to a violet-red, which no amount of acids can afterwards bring back to its original shade, and by oxalic acid it is converted to a fiery scarlet or orange. It is considerably more permanent than cochineal, probably because the particles of colour are accompanied by, and enveloped in a certain amount of resinous matter, which is never entirely wanting, even in the best and purest lacs.

This resin is the cause why lac is not, like cochineal, soluble in water, but requires either an acid or an alkaline solvent. The

liquids generally used for this purpose, are either sulphuric or muriatic acid, or the acid preparations of tin, in which most dyers subject the ground lac to a prolonged digestion, before putting it in the dye-pan.

Lac is now used to an immense extent for dyeing wool scarlet, orange, crimson, etc. Sometimes it is used alone, but when superior shades are aimed at, the goods are topped with cochineal which works brighter.

In woollen and delaine printing it is now also used with very satisfactory results, the difficulty which some years back was experienced in preparing it having been completely overcome.

Lactarine.—A barbarous and unscientific name, applied by a patentee to caseine, when prepared to serve as an animal mordant. See CASEINE.

Lactic Acid.—A very powerful acid, present in sour milk, and in a variety of fermented vegetable matters. It is a colourless liquid, which, when concentrated, marks about 43° Tw. It has been proposed as a substitute for tartaric in dyeing and printing.

Lake Colours.—A very numerous and important class of pigments, consisting of organic colouring matters in combination with sub-salts or hydrated oxides of tin, lead, bismuth, antimony, tungsten, aluminium, etc.

The number of *possible* lakes amounts to thousands, but as the majority of them are dull, chalky, fugitive, or possess at least no very distinctive character, they are not in use. Their only application is in pigment printing.

The simplest method of valuing a lake colour is to take a sample in fine powder, and observe how much of any white powder is required to let down a genuine sample to the same strength. Where such examinations are frequent, standard portions may be preserved, consisting of pure lakes let down respectively with 5, 10, 15, etc. per cent. of chalk.

Lamp Black.—This pigment consists of carbon in a state of great purity and extremely fine division. The farther these two points are carried, the more intense and the softer is the colour.

It is used in calico-printing as a pigment, and for this purpose

must be perfectly free from any gritty matter. It is perfectly proof against the action of light.

Chromates of Lead.—There are at least three chromates of lead, each of which can exist in several states, with a corresponding variation in colour. The *dichromate*, containing the smaller proportion of chromic acid, is sometimes a scarlet powder, nearly equal to vermilion; sometimes, according to the method of preparation, an orange-yellow, varying in intensity and brightness. The *neutral*, or monochromate, ranges from an orange to a lemon-yellow.

In dyeing and printing these compounds are generally produced upon the fibre. The præ-formed chromates of lead are in great demand as pigments. They should be soft, heavy, and free from everything gritty. For their valuation see LAKE COLOURS.

Lead Peroxide.—A compound of lead and oxygen, consisting of one equivalent of the former with two of the latter. It cannot be dissolved without undergoing decomposition, and when employed in printing it is produced on the fibre by saturating with some soluble salt of lead, and then employing some powerful oxidizing agent, such as hypochlorite of soda. The colour is a deep reddish-brown, or chocolate. It is now fallen into disuse, as similar shades can be better produced by other methods.

The peroxide of lead is still employed in the manufacture of aniline colours as an oxidizing agent.

Red Lead.—(*Minium.*)—A granular red powder, used as a paint. Like all the preparations of lead, it is liable to be blackened by fumes of sulphur, and is too dull and harsh to be employed in pigment styles of printing. It is an oxidizing agent.

Sugar of Lead.—(*Acetate of Lead.*)—Two kinds of sugar of lead are met with in the market, the brown and the white. The difference is that the former is prepared with a crude acetic acid, containing a considerable amount of tarry matter, whilst a pure, colourless acid is used in the manufacture of the white. The brown sugar of lead has a deep-brown colour and tarry odour. It is also harder and more compact than the white, and dissolves more slowly in water. It requires an equal weight of water at common temperatures for solution, but dissolves in half its weight

LIBRARY OF THE UNIVERSITY OF MICHIGAN

of boiling water. The brown kind generally leaves a certain amount of insoluble matter.

The chief impurities which are likely to interfere with its use are acetates of iron and copper. The detection of these impurities is not difficult. If ammonia be added in excess to the concentrated solution, a blue tinge will appear in the liquid should copper be present. If iron is suspected, the lead may be removed by carefully adding sulphuric acid to the solution, as long as a white precipitate is formed and deposited. The clear liquid may then be tested by the addition of a solution of ferro-cyanide of potassium (yellow prussiate of potash) which if iron is present, will occasion an immediate blue precipitate. Or some tincture of galls may be added, which will give a blue or black colour if iron be present.

Sugar of lead is chiefly used in the preparation of other acetates, such as red liquor, black liquor, etc. It serves also in dyeing chrome yellows.

Subacetate of Lead, or basic sugar of lead, is prepared by digesting a solution of the common sugar of lead in a loosely stoppered vessel with litharge. It has a great affinity for most colouring matters forming a series of lakes which are, however, of no great value. It is also used with the alkaline chromates in dyeing cotton yellow and orange.

Lead, Sulphate.—A heavy white powder composed of the oxide of lead and sulphuric acid. It is frequently formed by double decomposition, as in the preparation of red liquor, by the action of sugar of lead upon alum, a sediment of sulphate of lead is found at the bottom of the cask.

Although insoluble in water it has a great affinity for cotton, and enters into combination with it if applied in a moist state.

Lead, White.—(*Ceruse.*)—A pigment colour in very general use. It is a carbonate of lead, but not every carbonate of lead is white lead. That for instance prepared by precipitating the solution of nitrate of lead with an alkaline carbonate, would be at once rejected.

White lead is an unsafe colour on account of the ease with which it is attacked and blackened by sulphuretted fumes. It is grossly adulterated with chalk, gypsum, heavy spar, etc. Its only use in printing is in the pigment styles.

Lecanoric Acid.—A substance found by Schunk in orchella weeds, probably identical with orsillic acid.

Leukaniline.—A colourless base, formed by exposing ROSANILINE, or any of the varieties of magenta to the action of powerful de-oxidizers, such as nascent hydrogen. It is sparingly soluble in water and ether, but abundantly in alcohol. If exposed to oxidizing agents it turns red, and is reconverted into rosaniline. It has no direct application in printing or dyeing.

Lichens and Sea-weeds.—Besides the orchella-weeds, various sea-weeds and lichens possess tinctorial properties. Thus several species of Griffithsia yield a fine crimson extract with pure water, which forms lakes with alumina, etc. Some of the Algæ, of a brownish yellow colour whilst growing, when exposed to the air and sun, soon assume a deep red colour. *Lichen corallinus ventusis* and *tartareus* yield fine and permanent browns upon wool. A number of other species yield yellow and orange shades. None of them, however, are in use at present.

Light.—One of the principal modifications of force. As a chemical agent it is little inferior in its activity to heat and electricity, operating both combinations and decompositions innumerable, and leaving few bodies entirely unaffected. Colouring matters especially, which are for the most part of highly complex constitution, and become still more so upon combination with mordants, and with the fibre, feel its influence, for good or for evil. Upon dyed and printed tissues, once finished, its action is almost without exception, injurious. Magenta and safflower shades, the weed colours, certain aniline blues and violets, many wood colours, and especially lavender and peach shades, from whatever source, are often spoiled in a few hours if exposed to a really bright sunshine.

With colours *in preparation*, there is a want of unanimity as to its effects. Some maintain that for the production of really bright colours, either as pigments or upon the fibre, the sun's rays, or at any rate a very clear, diffused light is needful. This opinion is very generally held in France, by makers of carmine and of carthamine, and by silk and velvet dyers, who work as much as possible in the open air and in sunshine. The dyers of India appear

to hold a similar view. This opinion may be erroneous, but it is certainly corroborated by the fact that all natural productions, animal and vegetable, are most highly coloured in climates where the intensity of solar light is greatest, whilst the colours of plants kept in a gloomy place are dull and feeble.

To this, however, it may be replied that the action of light in the colouration of flowers may very probably be indirect, merely producing a more intense vitality. The light of tropical climates is further accompanied by a high temperature, which must necessarily complicate the results. Again it is certain that many of the finest colours, natural and artificial, are elaborated either in very subdued light, or in total darkness. The whole matter is one which calls for very careful experimental research.

As regards mordants, I am satisfied that the preparations of tin and iron lose their affinity for the fibre upon prolonged exposure to direct sun-light. This is especially the case with the nitrate of iron as used for royal blues. On the other hand, the same preparation is not deteriorated,—I might say is even improved by sunshine, for the manufacture of prussian blue as a pigment.

The chemical action of light appears to be of a de-oxidizing nature. It is often more energetic in the absence of a free access of air, and in some cases exposure to the air during darkness, reverses the changes produced by sun-light. Thus royal blues fade in bright sunshine, and recover during the night the tone they have lost during the day. Thus those metals whose affinity for oxygen is small, such as gold and silver, are reduced from their salts by sun-light, especially in contact with organic matter.

Lignine.—(*Woody fibre.*)—The fibrous part of wood and of the stalks and leaves of vegetables. It remains when wood has been successively extracted with ether, alcohol, water, dilute acids, and dilute alkalies.

Cotton, linen, hemp, jute, China grass,—in short all textile fibres derived from the vegetable kingdom are modifications of lignine, differing respectively merely in their structure and in the presence of foreign bodies in small quantity.

In its chemical relations lignine is very inactive.

Lima Wood.—A variety of soft red wood, generally considered superior to the ordinary peachwood, though less rich in colouring matter than the Pernambuco variety. In its uses and properties it agrees with BRAZIL WOOD, which see.

Lime, Carbonate.—Occurs to a vast extent naturally in the form of chalk, calc-spar, limestone, marble, etc. It is one of the principal causes of the hardness of spring and river waters, for though but very sparingly soluble in water it is easily dissolved by water holding carbonic acid in solution as is often the case with spring waters. When present it interferes with the mordants, and is unfavourable generally to the production of light and bright shades. (See WATER.)

In the form of chalk it is occasionally used to neutralize acids, which it does not accomplish to perfection, as an excess of chalk may be present along with free acid. Chalk is used in madder dyeing with many qualities of the ware.

Chalk is often contaminated with sand, ferruginous gravel, particles of flint, etc., and should be examined before use.

Lime, Caustic.—(*Hydrate of Lime.*)—At a strong red heat carbonate of lime parts with its carbonic acid and is converted into quick lime, with a considerable alteration of its properties. If mixed with water it combines with it equivalent for equivalent and becomes hydrate of lime. It has now an alkaline reaction upon vegetable colours, a burning corrosive taste and very much resembles caustic soda in its properties. If more water be added it becomes so-called *milk* or *cream of lime*, and in a still larger quantity is dissolved yielding a clear liquid known as *lime-water*. For solution lime requires 1310 times its weight of boiling water but only 730 parts of cold. Lime water is frequently used for neutralizing acids, precipitating the oxides of the heavy metals from their salts, in the indigo vat, etc.

Linseed.—Experiments have frequently been made to utilize the jelly or mucilage of linseed as a thickener for colours. Unfortunately, the oftener this jelly is heated the thinner and more watery it becomes, so that the colours soon assume quite a watery consistence.

Lithospermine.—A red colouring matter obtained from the root of *Lithospermum arvense*, a plant belonging to the same family

as alkanet. Like anchusine, lithospermine is soluble in oils and alcohol. It dissolves in alkaline carbonates with a blue colour, and is precipitated therefrom by acids in small red flakes. It differs however in some points from anchusine, as it dissolves in ether with a blue colour, whereas the ethereal solution of anchusine is red.

Logwood.—The most abundant and important of the dyewoods, obtained from *Hœmatoxylum campechianum*, a large tree growing on the coasts of the bays of Honduras and Campeachy, and in some of the Antilles, *e.g.*, Jamaica, and St. Domingo. The Campeachy growth is generally preferred.

The amount of tinctorial matter contained in logwood is very large, but concerning its nature there is difference of opinion. Some maintain that there exists in logwood only one colouring principle *hœmatoxylin*, sometimes less correctly named *hœmatin*.

The following properties are assigned to this principle. It forms clear brownish-yellow crystals, sparingly soluble in cold but readily in boiling water. The aqueous solution is reddened by nitric acid if very dilute. If the acid be concentrated the colour is destroyed. Baryta-water and solutions of the carbonates of potash and soda give very pale blue precipitates which pass through red into brown. Alum and chloride of tin give red precipitates.

By the joint action of ammonia and air hæmatoxylin is converted into *hœmatein*, a pulverulent body with a dark green metallic lustre, soluble in water with a brownish-red colour, and forming red solutions with dilute acids, and a violet liquid with ammonia.

Runge on the other hand finds in logwood three distinct præexisting colours, to which he gives the names "logwood-purple," "logwood siskin-violet," and logwood-violet.

The recently made decoction of logwood is of a yellowish-red, which becomes redder if concentrated. Acids render it a brighter and more transparent red. Solutions of the salts of iron turn it a blackish blue. Hydrated oxide of antimony turns it a splendid rosy purple. Chloride of zinc throws down a dull purple precipitate, leaving the liquor quite colourless. If heated with a solution of chromate of potash, either neutral or acid, it is blackened. The same change takes place also in the cold more gradually. The acetates of lead give blueish precipitates, the subacetate leaving the liquor nearly colourless.

The tinctorial principles of logwood are not very abundantly soluble in water. Cold water only takes up 1 per cent. of colour, and boiling water 2½. The aqueous decoction can afterwards be concentrated to any required strength—during which process a certain amount of tarry matter separates out—and even if required brought to a state of solidity. These decoctions are known as logwood-liquor, and extract of logwood.

The tinctorial principles of the wood are contained in the cold infusion in an unaltered state. In the decoctions they are more or less modified according to the heat they have undergone, the length of time it has been applied, and the greater or less access of air during the process. Logwood is very hard and dense, and to facilitate the extraction of the colour is always either reduced to thin shavings, chipped, or rasped to a powder. During and after these operations it is sprinkled with water and turned over from time to time before being considered fit for use. After it has been thus "feeding" for three months or thereabouts it is at its perfection. Great care must be taken, especially if the weather be warm, to guard against "heating," or "firing." Like all organic matter when moistened while in a state of fine division, the rasped wood condenses air in its pores and may in consequence rise in temperature even to ignition. Long before this point is reached the colouring matter is injured and the wood rendered worthless.

Some persons consider that the colouring matter of logwood is actually, in part at least, generated by the joint action of air and moisture. The more probable view is that the gradual absorption of water softens and swells the woody fibre and renders the colouring matters easier of extraction.

But though the action of moisture is within certain limits useful and even necessary—two parts of ripened wood being equal to three ground in a dry state—it is often added to such an extent as to become an adulteration. One hundred grains of rasped logwood as it comes from the dealers will when carefully dried at a steam-heat often lose 44 to 48 per cent. Now if we take the moisture naturally present in the wood at from 12 to 16 per cent., which is a fair average range, we find that some 32 per cent. of water has been superadded, and sold at the price of logwood. The writer knows from experience that an addition of 16 per cent. over and above the quantity natural to the wood is with good management amply sufficient to ripen it for use. The more

rapidly, however, the rasped wood has to be prepared for the market, the more water must be added, which is an additional reason for the use of an excess.

In addition to water, other substances are used, which must be pronounced fraudulent. The ground wood is sometimes sprinkled with stale urine, with lime water, or with a weak solution of soda ash. All these alkaline liquors give a temporary brightness and bloom to the ground wood, which thus passes for a superior quality, and they undoubtedly cause it to "bleed" more freely in either hot or cold water; but at the same time they impair the permanence of the colours produced. Of this anyone may convince himself by putting, say five grains of rasped logwood into each of two glasses, and pouring upon each two ounces of pure water. Add to one of them a drop of ammonia. It will be found that the colour in this glass will indeed be more rapidly extracted, but that it will also much more rapidly pass into a dirty brown humus-like colour.

The detection of these frauds is easy. The exact amount of moisture is readily ascertained by weighing out a portion, and weighing again after several hours exposure to a heat of 212° Fahr. An experienced person can form a tolerable idea of the amount of water by handling the ground wood. If it exceeds 43 per cent it may, unless very coarsely rasped, be moulded into a compact ball. But if it be 48 per cent or upwards, a few drops of water may be squeezed out of a handful, and the contents of the sacks when shot out will fall not in a loose powder but in heavy compact masses.

The presence of alkalies is also readily ascertained. A little of the wood is allowed to steep for a short time in cold distilled water, and a bit of delicate red litmus paper is then floated upon its surface. Should there be any alkali, a blue stain will appear upon the upper surface of the paper before its colour can be affected by the logwood liquor.

The comparative quality of samples of logwood may best be judged when they are dry. Those which exhibit the most stains and particles of a greenish bronze on the surface of the wood are the best. A large amount of black particles, the gruffs or gripps arising from the dark and porous outside wood, is not desirable. For greater accuracy, equal weights of the samples, say five grs. of each, may be taken and placed respectively in clear white glass phials or tubes of equal calibre and size. Upon

each is poured one ounce measure of methylated spirit, or of "EXTRACTING LIQUOR," and the phials are allowed to stand for an hour with occasional shaking. Upon comparison it is easy to see which has the strongest and brightest colour.

The extract or liquor of logwood is likewise open to sophistication. It is commonly sold at 8°, 10°, or 12° Twaddle, though for the use of fancy leather stainers it is prepared at strengths up to 24°. On the continent, and in America, a dry solid extract is in the market, formed by rapidly evaporating down the liquid kind, and this is generally the kind intended in foreign receipts for dyeing and printing. This solid extract, if preserved from damp, is not injured by keeping, and can be readily dissolved to any required strength. But the colour is invariably deteriorated by the contact of the air during the process of evaporating down, and the colours obtained from this solid extract are hence duller than those obtained direct from the wood or from a liquid extract of low strength. There are also paste extracts, which are very useful in printing.

In liquid extracts the indications of the Twaddle are not to be relied on, since these liquors are frequently "sprung," as it is technically called, with common salt, which raises the Twaddle, while it adds nothing to, or rather detracts from the value of the article.

To detect this fraud, a small quantity of the extract is placed in a glass tube and boiled with a few drops of pure nitric acid till the colour is destroyed. It is then diluted with pure water, and a few drops of nitrate of silver are added. If salt is present, a dense white curdy precipitate will form, and on the application of heat will subside to the bottom of the vessel.

The solid and paste extracts may not only contain salt, which is detected as above, but farina and extracts of chestnut bark. The comparative value of such samples may be ascertained by placing equal weights in phials or tubes, and adding equal quantities of methylated spirit as directed above.

For different purposes logwood is used in different states. For piece-dyeing, when the goods are smooth and non-adhesive like stuffs, the rasped wood is employed. For printing, the extract is preferred; as also for dyeing wool and slubbings, which could not be rinsed clean from the particles of the wood. Chipped wood is frequently employed for soft piece goods having a nappy surface to which the raspings would adhere, though here also the extract works cleaner.

Logwood is consumed principally for dyeing black along with chrome or iron. It yields also blues which imitate indigo-blues pretty well in shade, though inferior in stability. It enters also, both in printing and dyeing, into many browns, drabs, greys, slates, chocolates, lilacs, etc.

Madder.—Madder is the root of a plant known as *Rubia tinctorum*, a native apparently of Persia, but which has long been cultivated in Turkey, France, and Holland. Several plants of the same, and of allied families, contain colouring principles of a similar nature, and are occasionally used in its stead. The Turkey or Levant roots, known also as Lizari, are generally imported unground. The pieces are outwardly brown and of a light orange within.

Avignon madders (Palus) are imported sometimes whole and sometimes ground. The Dutch and Alsatian madders which are in great request for certain shades, but which do not equal the Avignon qualities, are mostly met with in commerce as a fawn-coloured or light reddish-brown powder. Madders dried and ground without removal of the bark of the root are known as gamene. Those ground after such bark has been removed are called *crop*, *crup*, and *grap* madders, whilst the smaller roots and refuse, ground up with a good portion of soil adhereing to them, are called *mull*. In mull madders I have found upwards of 50 per cent of mineral matter. In good qualities this does not exceed 5 per cent where the outer coat has been removed, and 9 where it has not.

By incinerating 100 grs. of the sample it is easy to detect the mineral adulterations and impurities, such as red ochre, brickdust, sand, clay, etc. These substances may also be discovered by what to some may be an easier process. A portion, say one oz., is put in a large glass jar, and stirred up with about 100 times its weight of water. The mineral matter settles to the bottom, whilst the madder remains floating in the water. This is carefully poured off and more water added, stirred up and again decanted off. By repeating this process a few times the whole of the impurities may thus be obtained in a separate state.

The amount of moisture in a sample of madder may of course be ascertained by drying a weighed portion in the usual manner.

A madder free from mineral falsifications may, however, still be adulterated with dye-woods, bran, sawdust, etc., or although genuine, may be naturally deficient in colouring matter. The

most reliable procedure is as follows:—1000 grs. of the sample are mixed with an equal weight of pure sulphuric acid at full strength, and allowed to stand for some hours at a common temperature. The mass is now mixed with water, poured upon a filter, washed as long as the washing reddens blue litmus paper, and then dried at 212° Fahr. By this means the madder is converted into garancine, all the colouring matter being brought into a soluble state. When the mass is dry it is well powdered and steeped in cold alcohol mixed with a little ether, in order to remove any fatty matter. This process is repeated three times, the alcohol being each time carefully filtered off. It is next boiled in about 5000 grain measures of alcohol at sp. gr. 0·834. This operation is best performed in a large glass retort, and is also three times repeated, to extract the last traces of colouring matter. The three alcoholic extracts are now mixed together and evaporated down in a glass retort. Finally, when the residue begins to take the consistence of syrup, it is transferred to a light porcelain capsule previously tared, and is then evaporated to dryness at a gentle heat.

By this method any other colouring matters present are got rid of during the washing, after treatment with sulphuric acid, and do not affect the final result.

Another method is to dye pieces of calico of equal weight with the various samples, and compare the depth and purity of the shades obtained with those yielded by various known weights of a madder of good quality. It is first necessary to provide some pieces of calico, equal in weight and about three inches square. These are carefully mordanted with red liquor, the original strength of which, the quantity actually used, the amount of water, the temperature and time, are all noted down. They are then rinsed, hung up to drain, and dyed as follows:—A water or steam bath is selected capable of heating a sufficient number of wide-mouthed flasks, and containing water at about 102° Fahr. Into each flask is put 1½ pint of distilled water, a piece of the prepared calico, and a weighed quantity of one and the same kind of madder, which should range in the set of flasks from 10 grs. up to 150. A thermometer should be fixed in the water-bath, the temperature in which should be gradually raised, so that it may reach 167° Fahr. in 90 minutes without fluctuations. The heat is then raised to the boiling point for half-an-hour. The pieces of calico are now withdrawn, rinsed in cold water and dried. Each

swatch of dyed calico is now cut into two equal portions, one being preserved in that state, and the other steeped for half-an-hour at 106° Fahr. in a soap bath, made of 25 grs. of white curd soap, and 1½ pint of water. The calico is now taken out, rinsed in cold water, and again put in a fresh soap bath, having the same proportions of soap and water, with the addition of 8 grs. of tin crystals, in which it was allowed to boil for 30 minutes. The swatches are lastly well rinsed, dried, and preserved from the light.

In order to test any samples of madder, pieces of calico, of the same weight as those employed above, are mordanted with the precautions above given, and dyed with known weights of the various samples. The calico thus dyed is compared with the scale of pieces preserved for reference, and the value of the samples is thus comparatively ascertained.

Madder is a highly complex body, containing woody fibre, gum, sugar, pectine, and a variety of colouring matters, which are, according to the latest researches, ALIZARINE, MADDER-ORANGE, PURPURINE, PSEUDO-PURPURINE, and XANTHO PURPURINE. Of these, alizarine, the red colouring matter, is the most important. It is, when pure, a solid body readily crystallizing, forming when sublimed orange-coloured needles. It is soluble in warm alcohol and in benzol, and gives with alkalies a blueish-violet solution. Purpurine is a solid, exhibiting red crystalline needles. It dissolves in the same solvents as the last, but its solution in the alkalies is of a redder shade than that of alizarine. Pseudo-purpurine forms small brick-red coloured needles, which, when heated, yield purpurine by decomposition. It is soluble in benzol but dissolves very sparingly in alcohol, even at boiling point. Its solution in alkalies is red. Madder-orange forms irregular crystalline mass. It also is converted into purpurine by heat. It is insoluble in benzol and in alkalies, but very soluble in alcohol. Purpuro-xanthine forms yellow crystals, and gives yellow solutions with the alkalies. It dissolves in alcohol and benzol. The value of these colours decreases exactly as their per centage of oxygen increases, alizarine containing the least. By means of suitable reducing agents, the less valuable colours may be converted into alizarine.

Flowers of Madder.—Known also as *Refined Madder, Madder Bloom, and Fleur de Garance.*

If madder is exposed for a day or two to the action of cold water, little or nothing of the colouring matter is taken up, but a large amount of useless substances—nearly half the weight of the original madder—is made soluble and can be removed.

The residue, when dried, has a pale colour, a faintly acid smell, and is used in the preparation of colorin, azale, etc. For some styles of dyeing and printing also, it is preferable to crude madder.

Mafurra Oil.—A kind of grease or fat, nearly approaching to palm-oil. It is extracted by means of hot water from the so-called Mafurra or Mafutra almonds, the seed of a fruit not thoroughly known. 65 per cent. of oil can be obtained from the husked seeds.

The oil has a yellowish colour, and an odour like that of the chocolate nut. It is less easily fusible than tallow, and is easily saponified. It yields palmitic acid in a high degree of purity. The seeds from which it is obtained, are very abundant on the Eastern coast of Africa. It is, therefore, to be regretted that it is not yet a regular article of commerce.

Magdala Red.—(*Naphthaline Red.*)—This colour occurs in the form of a brownish-black, somewhat crystalline powder. It dissolves in alcohol, forming an intense red solution, from which, on evaporation, it is obtained in greenish crystals of a metallic lustre. It dyes on silk and wool, shades more approaching to pink and rose-colour, than the reddest magenta. There are, however, difficulties in its manufacture on a large scale, which have not been entirely overcome. In consequence the product is variable.

Magenta.—The ordinary trade name given to certain bright blueish-red colouring matters, produced by the action of oxidizing agents upon ANILINE, and supposed to be compounds of a base known as ROSANILINE, with certain acids. Thus the variety sold as "roseine," or "acetate of magenta," is an acetate of rosaniline, "fuchsine," "fuchsiacine," or "fuschine," are hydrochlorates of the same base, whilst "azaleine," and "rubine" are nitrates. Other points being equal, the acetates appear to be the most beautiful.

Magentas vary greatly in brightness as well as in shade, some

approaching more to a scarlet, whilst others tend to the blueish tones of red.

Magenta, in the dry or solid state, forms bright golden-green crystals or masses. In some of the very finest qualities, the green verges upon a blueish shade, but in less perfectly refined sorts it has a yellowish, brassy, or olive reflection.

Magentas are supplied to consumers either in a liquid state —the earliest form—in irregular lumps, or in small crystals. The latter are generally preferable as being both purer and more readily soluble than the lumps.

Magenta may contain certain impurities and adulterations. *Sugar*—either cane or starch—may have been added. To detect this, a small portion is treated with the most concentrated alcohol. The colouring matter dissolves, and may be filtered off, whilst the sugar remains behind.

Tarry matters and raw *aniline* may be present, if the refining process has been carelessly or unskilfully managed. These, even to the smallest extent, interfere very materially with the beauty and brightness of the colour. They may be detected by dyeing swatches of equal weight, with known quantities of the samples dissolved in the same manner, and comparing the brightness and purity of the shades produced. The same method obviously serves to indicate the comparative strength of different kinds.

Another method of examining magentas is to dissolve in alcohol, dilute with about an equal bulk of water, and by means of a glass rod, throw a drop of the liquid upon a piece of white blotting-paper. If more than one colouring matter is present, the different shades will diffuse themselves in concentric circles, and may be distinctly seen.

Magenta is soluble in acetic acid, in alcohol, in glycerine, in boiling water, which, on cooling, deposits the greater part in crystals. It is also soluble in the extract or decoction of Panama bark. Some time back, it was generally dissolved for use in very large proportions of alcohol to the extent of 10, or ever 20 times its own weight. This excess of spirit is now found to be not merely unnecessary, but rather injurious than beneficial. An excess of alcohol blues the magenta, diminishes its brightness, and renders it liable to flush on the surface of the goods to be dyed.

To do full justice to the finer qualities of magenta, especially when shades are desired approaching those given by CARTHAMINE,

the crystals may be left to steep for a few hours in about their own weight of alcohol or methylated spirit. Afterwards about thirty times the weight of water, and three to six times the weight of glycerine may be added, the whole boiled up together, strained and used. The longer, however, it is intended to be kept in solution before it is used, the more alcohol and glycerine are necessary.

When the colour is to be applied hot, as in dyeing wool and worsted, the use of spirit may be entirely dispensed with by a very simple arrangement. The quantity of magenta needed is tied up in a small flannel bag. A piece of flannel is fixed to a wooden hoop, and laid across a corner of the dye-pan, forming a filter. The bag of magenta is placed upon it and hot water from the dye-pan is poured upon it and allowed to run back into the dye-pan till all is dissolved.

The tinctorial power of magenta is prodigious, and its affinity for silk and wool, indeed for all animal matters very great, no mordant being required. For cotton its affinity is much slighter, and to give anything more than a fugitive stain mordants are requisite. These are either the animal mordants—used mostly in printing—or astringents along with salts of tin and alumina, means employed more in dyeing.

At the best, magenta is not a very fast colour. A few hours exposure to full bright sunshine generally suffices to injure very strikingly ribbons, curtains, etc., of this shade.

By acids magenta is turned more to the blue side, but except the quantity employed be very small the colour is at the same time dulled and impoverished. Alkalies, under certain circumstances have the contrary effect, rendering the colour both redder and brighter.

By a very simple method magenta can be so modified as to take upon cotton as a very bright rose, without mordant, having at the same time but a very feeble affinity for wool.

Magenta shades upon goods of any kind may be known from other reds by the circumstance that they are dulled and impoverished by weak ammonia.

Magnesia, Carbonate.—This substance is now found native in great abundance as *Magnesite* and is being introduced into the market. Where it is desired to neutralize an acid the carbonate of magnesia is preferable to soda-ash since 42 parts are

equal to 53 parts of absolutely pure soda-ash at 58 per cent., and to 143 parts of soda-crystals.

Magnesium Chloride.—(*Muriate of Magnesia, Weighting Liquor.*)—A compound of magnesia and chlorine. It forms a clear, colourless liquid, neither acid nor alkaline, and of very great specific gravity, being generally sold at 140° to 150° Tw. It attracts moisture from the atmosphere, and is used for weighting woollen and cotton goods, where it not unfrequently occasions mildew.

Magnesia, Hypochlorite, known also as *Chloride of Magnesia and Bleaching Magnesia.*—This compound is prepared as a liquid by dissolving the common CHLORIDE OF LIME in cold water in a covered vessel, and adding to the clear liquid a solution of Epsom salts as long as a white turbidity is formed.

It is far superior to the chloride of lime. The fibre is left in a softer, more supple and kindly state, and colours subsequently applied are brighter.

Magnesia Sulphate, or Epsom Salts.—A well-known colourless and very soluble salt. 10 lbs. of the salt dissolve in 8 lbs. of water at 65° Fahr., forming a liquid which marks 58° Tw. In hydrochloric acid it dissolves much more copiously.

It is used along with chloride of lime in preparing the CHLORIDE OF MAGNESIA or bleaching magnesia. It serves also to fix lead mordants for chrome yellows in calico-printing. It has been applied with success as a mordant for ANILINE GREENS.

It may also be occasionally met with as an adulterant in tin spirits.

Malic Acid.—This acid occurs naturally in many fruits, especially in the apple, the berries of the mountain ash, and the juice of rhubarb stalks. It is more soluble in water than the citric and tartaric acids and is not very readily obtained in crystals.

It has the character of rendering aniline colours more permanent, but is very sparingly used, probably on account of its high price.

Manchester Yellow.—(*Jaune d'Or, Naphthylamine Yellow.*)

—The most splendid yellow colouring matter known, prepared from napthalin.

Its tinctorial power is still greater than that of picric acid, to which it is in many respects analogous.

It produces upon silk, wool, and leather, brilliant shades of a pure gold, without the greenish cast of picric acid. It possesses the further advantage that the colours which it yields admit of being steamed, which is not the case with those given by picric acid.

Manganese.—A metal, hitherto without use in the metallic state, but forming several compounds of great importance in the arts. Of these the black oxide or peroxide is the principal. It is found native in large quantities as pyrolusite, brown-stone, and wad. It is used to generate chlorine gas in contact with spirits of salt, and thus serves in the manufacture of bleaching powder, etc.

The sulphate and muriate of manganese are used in producing certain so-called bronze shades upon cotton. They are not in large demand at present. They should be free from iron, and give with a solution of the prussiate of potash a very pale flesh colour precipitate, without the faintest trace of blue.

Manganese forms also two compounds, which play the part of an acid in contact with potash or soda, namely, the manganic and permanganic acids. These acids and their salts are powerful oxidizing agents, and produce full and permanent browns upon calico. They are also used in the manufacture of colours as oxidizing agents.

Mango.—A name given in the linen districts of Ireland to bleaching-powder and bleaching-liquor.

Mangrove Bark.—The bark of the mangrove was once employed in dyeing certain brown and drab shades upon cotton. Presenting no distinct advantage it has fallen into disuse.

Mauveine.—An organic base, derived from aniline. Many of the aniline violets are compounds of this principle. It is so powerful a base as to expel ammonia from its salts. In a pure state it is a black sparkling powder. It forms well-defined salts with the acids.

Measures and Weights, according to the French system, with their English equivalents.

MEASURES OF LENGTH.

Millimetre	=	0·03937	inch
Centimetre	=	0·393708	„
Decimetre	=	3·937079	inches
Metre	=	39·370790	„
„	=	3·2808992	feet
„	=	1·093633	yard
Decametre	=	32·808992	feet
Hectometre	=	328·08992	„
Kilometre	=	3280·8992	„
„	=	1093·633	yards
Myriametre	=	10936·33	„
„	=	6·2138	miles

Inch	=	2·539954	centimetres
Foot	=	3·0479449	decimetres
Yard	=	0·91438348	metre
Fathom	=	1·82876696	metres
Furlong	=	201·16437	„
Mile	=	1609·3149	„

SUPERFICIAL MEASURES.

Square millimetre	=	$\frac{1}{645}$	of a square inch
„ „	=	0·00155	„
„ centimetre	=	0·155086	„
„ decimetre	=	15·5086	inches
„ „	=	0·10769	square foot
„ metre or centiare	=	1550·86	square inches
„ „ „	=	10·7698	square feet
„ „ „	=	1·196033	square yard
Are	=	1076·98	square feet
„	=	119·6033	square yards
„	=	0·098845	rood
Hectare	=	11960·33	square yards
„	=	2·471143	acres

SUPERFICIAL MEASURES.—*Continued.*

Square inch . .	=	645·109201	sq. millimetres
„ „ . .	=	6·45109	sq. centimetres
„ foot . .	=	9·2903	sq. decimetres
„ yard . .	=	0·836097	metre
Acre . . .	=	0·404671	hectare

MEASURES OF CAPACITY.

Cubic millimetre .	=	0·000061029	cubic inch
„ centimetre (millilitre) .	=	0·061029	„
10 cubic centimetres (centilitre)	=	0·61029	„
100 cubic centimetres (decilitre)	=	6·1029	„
1000 cubic centimetres (litre)	=	61·0295688	„
„ „ .	=	1·760773	imperial pint
„ „ .	=	0·2200967	„ gallon

WEIGHTS.

Milligramme .	=	0·015438395	grain.
Centigramme .	=	0·15438395	„
Decigramme .	=	1·5438395	„
Gramme . .	=	15·438395	„
„ . .	=	0·643	pennyweight.
„ . .	=	0·03216	oz. troy
„ . .	=	0·03527	oz. avoirdupois.
Decagramme .	=	154·38395	troy grains.
„ .	=	5·64	drams avoirdupois.
Hectogramme .	=	3·2154	ozs. troy.
„ .	=	3·527	ozs. avoirdupois.
Kilogramme .	=	2·6803	lbs. troy.
„ .	=	2·2054	lbs. avoirdupois.
Myriagramme .	=	26·803	lbs. troy.
„ .	=	22·05486	lbs. avoirdupois.
Quintal metric (100 kilogs) .	=	220·5486	lbs. avoirdupois.
Tonne metric (1000 kilogs)	=	2205·486	lbs. avoirdupois.

WEIGHTS.—*Continued.*

Ton . . .	=	1015·649	kilogs.
Hundredweight	=	50·78245	„
Quarter . .	=	12·6956144	„
Pound . .	=	453·4148	grammes
Ounce . .	=	28·3375	„
Dram . .	=	1·77168	„

Troy.

Pound . .	=	373·096	grammes.

Decalitre . .	=	610·295688	cubic inches.
„ . .	=	2·2009668	imperial gallons.
Hectolitre .	=	3·5317	cubic feet.
„ . .	=	22·009688	imperial gallons.
Cubic metre stere or kilolitre	=	1·308	cubic yard.
	=	35·3171	cubic feet.
Myrialitre. .	=	353·171	cubic feet.

Cubic inch .	=	16·3855	cubic centimetres.
Cubic foot .	=	28·3159	„ decimetres.
Cubic yard .	=	0.764520696	metre.

Pint . .	=	0·567932	litre.
Quart . .	=	1·135864	„
Gallon . .	=	4·54345797	„
Peck . .	=	9·0869159	„
Bushel . .	=	36·347664	„
Sack . . .	=	1·09043	hectolitre.
Quarter . .	=	2·907813	„
Chaldron . .	=	13·08516	„
Ounce troy .	=	31·0913	grammes.
Pennyweight .	=	1·55457	„
Grain . .	=	0·064773	„
Apothecaries' dram	=	3·8869	„
Scruple .	=	1·29546	„

Mercury, Chloride.—(*Corrosive sublimate.*)—A compound of mercury with chlorine. It is a colourless crystalline body, soluble in water and still more so in alcohol. At a strong heat it is totally volatilized, condensing upon any cold object in a beautiful frost-work. Its chief use in the tinctorial arts is as a mordant

for murexide or Roman purple. It is not very stable in contact with organic manner, and is readily decomposed by metallic zinc, iron, or copper, which circumstance is an obstacle to its employment in printing. With the iodide of potassium it yields a beautiful scarlet precipitate, known as "geranium-red"—the iodide of mercury.

Molybdenum.—One of the rarer metals, capable of forming various blue compounds, some of which are capable of being used in dyeing and printing. The molybdate of ammonia has been made to yield good medium blues upon silk and cotton. The molybdate of soda gives lighter shades. It is not in use at present, and does not appear to offer any decided advantage.

Monarda.—The scarlet flowers of *Monarda didyma*, according to the researches of Belhomme, contain a colouring matter identical with that of cochineal, and may be advantageously employed in the manufacture of carmine.

Mordants.—Mordants are a class of bodies which serve to fix colouring matters upon the fibre. Few colours have the power to attach themselves alone to either wool, silk, or cotton. As a rule, when applied in this manner, they produce merely a faint and fugitive stain, not worth calling a dye. And even those few (see SUBSTANTIVE COLOURS) which are able to lay hold of the fibre alone, are generally rendered both brighter and more permanent by the intervention of a mordant.

A variety of attributes are necessary for a good mordant. It must have a strong affinity both for the fibre and the colour, and be capable of combining readily and permanently with both. Yet these affinities must not be *too* strong. If it combine too eagerly with the fibre, the result will be unevenness; those parts of the goods which first enter the dye-pan, or which are in any way more readily acted on, will receive more than their share, and other portions less. Again, if the mordant have a much stronger affinity for the colour than for the fibre, the result is that instead of depositing the colour on the cloth, a *lake*, or coloured precipitate will be formed, which subsides to the bottom of the dye-pan, leaving the goods very meagerly and loosely covered. Thus many metallic compounds capable of forming fine lakes with this or that colouring principle, are quite incapable of filling the part of

mordants. It is essential that the mordant should combine both with the fibre and the colour with regularity, and at a moderate rate, so that the compound formed may not be loosely plastered over the surface of the fibre, but penetrate into its pores. The result otherwise will be uneven, fugitive, and dull.

Further, the mordant must, in the state in which it is used, be incapable of injuring the fibre. If it be of a corrosive nature, whether from excessive acidity or alkalinity, the texture of the goods will be injured. Its action upon the colour is also important. This must not be dulled or deadened, but, if anything, brightened by combination with the mordant.

It is, likewise, desirable that a mordant should not, by itself, affect the colour of the fibre. If it, as is the case with the salts of iron and copper, possesses any tinctorial power of its own, its use is necessarily restricted to one particular class of shades.

Mordants, as a matter of course, must be soluble, and be presented to the fibre and the colour in a liquid state. But they must likewise be capable of readily becoming insoluble when the combination is effected. If not, it, together with the colour, would be at once removed by washing. This change from solubility to insolubility, is accomplished in various manners. Sometimes it is the mere result of new combinations being formed, the mordant and colour, each of them soluble by itself, form an insoluble compound when they come together. Sometimes the mordant when brought in contact with the fibre in a dilute state is decomposed, leaving an insoluble subsalt in combination with the fabric. Sometimes the insoluble state results from the escape of a volatile acid; thus, if a piece of cotton is moistened with the acetate of alumina, and is then dried, the acetic acid escapes, and the alumina remains upon the fibre in an insoluble state.

From this consideration it appears that such substances only are capable of acting as mordants, as are in their constitution unstable, their components being only held together by a feeble affinity, readily overcome. Highly stable permanent compounds, refuse to hand over any of their constituents to the fibre. Thus alum, a very permanent salt, is a weak mordant; but if it be converted into basic alum, whose constituents are held together by a feebler tie, it becomes more efficient. Many of the most approved mordants undergo spontaneous decomposition if kept for a length of time. This is the case with "scarlet spirits," and with the nitrate of iron.

Mordants are specific, not general. In other words, a substance very efficacious upon one fibre is not necessarily suitable for others; and though admirably adapted for certain colouring matters it may be nearly useless, or even mischievous for others. Thus upon cotton certain salts of iron, the acetate and the nitrate, are valuable mordants, but they are not adapted for wool. Tin is the mordant for cochineal and lac; but it is as decidedly not the mordant for madder.

In considering the applicability of a mordant for any purpose, we have to look not only to the base or metallic oxide present, but to the acid with which it is combined, and which greatly modifies its properties. An excess of acid not only injures the fibre to be dyed or printed, but holds back the base from being deposited in sufficient quantity upon it, giving the work a meagre appearance. On the other hand if the mordant be too "dead," as it is technically styled, the base will be delivered too rapidly, and the colour uneven and generally dull.

Some acids deliver the base most readily to wool, and others to cotton. Thus either tin or iron dissolved in nitric acid is more readily deposited upon cotton than if hydrochloric acid were the solvent, the latter being more disposed to hand over its base to wool. Thus if a swatch of delaine is steeped in water containing nitrate of iron, the warp will be coloured buff by oxide of iron. If it be treated with the muriate of iron instead of the nitrate, the worsted is acted upon, whilst the cotton warp comes out nearly colourless. One reason for this different action of the two salts is that the nitrate of iron is a much less stable compound than the muriate. Now, as cotton is generally dyed or mordanted in the cold, it is able to take the base from the nitric acid, though unable to overcome the more powerful affinity of the muriatic.

Wool and worsted, on the other hand, being dyed at a higher temperature, are able, with the advantage of the heat, to take the base from the muriatic acid. The matter deposited upon the fibre is in most cases not a mere oxide of tin, of iron, etc., as the case may be, but a sub-salt, containing a portion of the acid which was present. Thus the colours respectively produced upon wool, if boiled along with logwood and the sulphate or the muriate of tin, are not alike; the former being a redder shade than the latter.

Mordants are either applied along with the colouring matters, previous to them, or subsequently. The first is the general procedure for wool-dyeing, and the second for cotton.

The principal mineral mordants are alumina, tin, iron, copper- and chrome; lead, arsenic, antimony, bismuth, manganese, nickel, cobalt, tungsten, mercury, zinc, and magnesia, have also been occasionally employed. Even salts of soda, such as the hypo-sulphite, borate, and silicate perform, with certain artificial colours, functions which cannot be viewed in any other light.

It is, indeed, highly probable that as the employment of pure isolated tinctorial principles as distinguished from crude dye-wares is extended, our catalogues of mordants will become more extensive.

Mordants, Organic.—Setting aside the astringents, which we have considered elsewhere, organic mordants may be referred to two classes—albuminoid substances and their kindred, and secondly, oily and fatty bodies. Substances belonging to the former class, have been very extensively used by printers for fixing upon cotton the aniline colours, archil, picric acid, and other dyes which have but a feeble affinity for that fibre.

The action of these substances is totally unlike that of the mineral mordants we have been considering above. They have a very strong tendency to combine with the colouring matters for which they are employed; but to the fibre they merely cling in a mechanical manner, forming a coating, like paint or varnish over its surface. The matter that is really dyed or printed is not the cotton, but the thin film of albumen which has been deposited upon it.

The principal mordants of this class are albumen, derived from eggs, from blood, or from the roe of fishes; caseine, or, as it is improperly called, "lactarine," and gelatine. Glutine, or vegetable fibrine, along with other substances of an analogous nature, have also been to some extent applied.

All these bodies agree in being highly nitrogenous, but there is no indication that they transfer any nitrogen to the cotton fibre, or exert any chemical action upon it whatsoever. As I have already stated, they merely infold it in a layer of matter which, in its relations to colouring matters, resembles wool or silk.

Sulphur, in a state of organic combination, is doubtless present in albumen, caseine, etc., just as it is in wool. Nevertheless, as it is absent in one body, which is perfectly capable of acting as an "animal mordant," the theory that such sulphur is the essential element upon which the affinity of aniline colours for the fibre depends cannot be exclusively correct.

The use of nitrogenous organic mordants is less extensive in dyeing than in printing. In piece dyeing there are great difficulties in applying these mordants to the goods with evenness and regularity, and, consequently, though beautiful shades are obtained, they vary in depth in different parts of the roll. In wool and slubbing-dyeing the glutinous nature of these mordants renders them inapplicable.

It is remarkable that the affinity of wool for certain colours is heightened by preparation with mordants of this class, shades being obtained which are richer and faster. Woollen and worsted yarns have been very successfully treated in this manner.

For the second class of organic mordants, the reader is referred to OILS.

Munjeet.—(*Mungeet, or Manjit, Indian Madder.*)—The root of *Rubia munjista*, a plant of the madder family, cultivated in India, where it is extensively used by the natives in dyeing.

It is met with in bunches of stalks which are nearly a yard in length, and which vary from the thickness of a finger to that of a quill.

It contains alizarin, the red colouring matter found in madder. It is capable of conversion into garancine by treatment with sulphuric acid, in which state it is chiefly used.

The roots when used for dyeing in the raw state are said to be much improved by being boiled up with a decoction of some astringent matter such as galls or myrobalans.

Muriates of Tin, single and double.—The muriates of tin are solutions of tin in hydrochloric, or as formerly called, muriatic acid. From tin crystals they differ merely in their liquid state, and in containing relatively less tin and more acid and water.

In strength they vary greatly. Single muriates run from 40° to 60° Twaddle, and double muriates from 70° to 120°. The former contain 1 to 2 ozs. of metallic tin in the pound, and the latter from 2½ to 5 ozs. The strength as indicated by Twaddle or by any other hydrometer is, however, a key to the value only in case of genuine samples. Many muriates in the market are adulterated with oil of vitriol, sulphate of magnesia, sulphate of zinc, chloride of zinc, etc. The very price at which some samples are offered, taken along with the current prices for tin proves at once that they cannot be genuine.

For the detection of these impurities and for a method of estimating the amount of tin, the reader is referred to TIN-CRYSTALS.

It must be remembered that small quantities of sulphuric acid may be present in the muriates of tin without any fraudulent intention on part of the maker, if the hydrochloric acid employed contains, as is often the case, some sulphuric acid as an impurity.

The double muriate of tin must not be confounded with the bichloride; the tin in both "single" and "double," being entirely in the state of protochloride.

The uses of the liquid muriates of tin are very similar, both in dyeing and printing, to those of tin-crystals.

Iceland Moss.—(*Irish Moss, Carragheen Moss.*)—These names are applied to certain lichens which, with boiling water, yield a gelatinous matter approaching the nature of starch. From true starch it is distinguished by its behaviour with iodine, with which it gives not a deep blue, but a dirty green. For thickening colours it is not well adapted, but it is used for finishing purposes, and in the preparation of certain "assistant oils," or liquids used to mix with the oils employed in the woollen manufacture.

Murexide.—(*Purpurate of Ammonia.*)—A splendid colouring matter, which when pure, forms crystals of a golden green colour by reflected, but of a garnet red by transmitted light. It yields a reddish-brown powder, which takes a golden green lustre if rubbed with a hard smooth body. It is insoluble in alcohol and ether, but dissolves readily in boiling water.

Its source is the uric acid obtained in greatest purity from the excrements of serpents, but more abundantly from Peruvian guano.

It is used under the name of Roman purple for dyeing certain brilliant reddish purple shades on silk, with a mordant of the chloride of mercury. It is not well adapted for wool-dyeing, and is at the best not very permanent. With acetate of zinc it gives a yellow.

The purpuric acid present in murexide is a totally different body from the purpuric acid obtained from indigo, but differs little in its properties from isopurpuric acid.

Myrobalans, sometimes called *Myrabolans or Myrabolams.*—A fruit produced in India, and very extensively consumed in

Europe as a source of tannin. The myrobalan is in shape and size like a slightly shrivelled plum. It is of a pale buff colour, and consists of a fibrous cellular matter of various thickness enveloping a stone. The entire weight of a myrobalan varies from 20 to 300 grs., of which the stone forms from 23 to 52 per cent. The moisture in the nuts as imported varies from 3 to 7 per cent. When reduced to ashes they leave about 10 per cent. of mineral matter. The tannin is mainly seated in the dried pulp enclosing the stone, and is very variable in amount, but on the average exceeds that found in the best sumachs.

As imported they are sometimes found, through the carelessness of the natives who collect them, mixed with earth, sand, nux vomica (strychnia nuts), betel nuts, and a variety of seeds and berries.

Good myrobalans should be of a pale colour, plump, or but slightly shrivelled, free from blackish stains or blotches and from worm holes. When shaken together they should ring like fragments of earthenware. They are hard and firm, and when beaten with a hammer they should break up into a light-coloured dry powder and irregular fragments. If they crumble between the fingers into a dark coloured dust, or if they spread out under the hammer into a paste, they are inferior. The smaller the proportion of stones to pulp, the better. To determine this essential point, weigh 50 nuts taken fairly from the bulk, then break them up with a hammer or a pestle, clear the stones from any adhering pulp and weigh them separately. The smaller their relative weight the better is the sample.

For methods of determining the amount of tanning matter—see DIVI-DIVI.

Ground myrobalans should be light in colour, dry, free from a saline or an intensely bitter taste. When slightly moistened and rubbed in the hand they should adhere very tenaciously to the skin, almost like bird-lime.

Ground myrobalans, in addition to the accidental impurities found among the unground nuts, may be contaminated with finely ground divi-divi, and with old and worthless sumac, and with wild galls. To detect these impurities portions of the powder are finely scattered upon a sheet of white paper, or upon a plate of glass and examined with a lens. If divi is present, fragments of its brown, flat, pea-like seeds are nearly certain to be found. These from their hardness and smoothness escape being crushed

to powder. The outside skin of a myrobalan sometimes approaches a divi seed in colour, but even the smallest fragment of the former exhibits a wrinkled surface, whilst the divi seeds are smooth.

The leaf-stalks of sumac are also easily distinguished under the lens from the torn and jagged fibre of the myrobalan nut.

The uses of myrobalans are the same as those of other matters containing tannin. Being much cheaper than galls and much stronger than sumac, they are rapidly superseding both these wares, except in a few special cases. In conjunction with preparations of iron, they dye the cotton warps of stuffs a fuller black than can be obtained with sumac. As a mordant for fixing aniline colours upon cotton, they are likewise preferable, probably on account of the oily and glutinous matters accompanying the tannin, and which are not present in sumac. For such purposes, however, the palest qualities of myrobalans should always be selected.

Naphtha, Wood.—(*Methylic Alcohol, Wood-spirit, Pyroxilic Spirit.*)—This liquid must not be confounded with "methylated spirit," which is a mixture of common spirit of wine, or ethylic alcohol, with about 10 per cent. of wood naphtha.

Wood naphtha is a clear, colourless liquid, highly inflammable, of peculiar aromatic odour; of specific gravity 0·79. It generally contains lignone and traces of empyreumatic oil. As a solvent, it acts very similarly to common alcohol.

It is used to some extent as a solvent for aniline colours, the shades produced being different, and in some cases preferable to those obtained when methylated spirit is the solvent. The chief impurity to be dreaded is resinous matter, which is detected by adding water, when it separates as a grey turbidity. It may occasion much inconvenience in dissolving colours.

Naphthaline.—One of the secondary products of the gas-manufacture, or of the destructive distillation of coal. When pure, it forms thin white flakes of a pungent taste. It is insoluble in water, but dissolves readily in alcohol, ether, and in the acetic and oxalic acids. It melts at 79° Fahr., and has the specific gravity 1·045.

It is not readily inflammable, and burns with a smoky flame.

Of its very numerous compounds, the only one as yet applied on a practical scale to tinctorial purposes, is the MANCHESTER YEL-

low, but it is highly probable that others will be found valuable when further investigated. As far as can be deduced from theoretical considerations, it is probable that they will be more permanent than the derivatives of aniline.

Nitric Acid.—(*Aqua-fortis.*)—One of the strongest and most useful mineral acids, consisting of 1 equivalent, or 14 parts by weight of nitrogen, combined with 5 equivalents, or 40 parts of oxygen. In this state it is a solid body, known merely as a chemical curiosity, and never occurring in commerce. The strongest known liquid acid, consists of 1 equivalent of water, or 9 parts by weight united to the above. In this state it is, if pure, a clear, colourless liquid, of a sharp suffocating odour, and intensely sour taste, containing 85·7 per cent. of the dry acid above-mentioned, and having a specific gravity of 1·52, or 104° Tw.

At this strength, however, it is rarely used on the large scale. The ordinary "double aqua-fortis" of commerce, has the specific gravity 1·325 or 65° Tw., or thereabouts. "Single aqua-fortis" stands generally at 33° Tw. or 1·165.

Nitric acid is prepared by heating, in appropriate vessels, sulphuric acid along with the nitrate of potash, or more generally, the nitrate of soda. The nitric acid distills over, and is collected in suitable receivers.

The nitric acid of commerce is subject both to accidental impurities and intentional adulterations, which may at times seriously interfere with its uses. As commonly sold it is very rarely colourless, but of a tinge varying from pale yellow to brownish orange. This arises from some of the lower oxides of nitrogen, especially hyponitric acid, formed by the decomposition of some part of the nitric acid. This impurity may be easily removed by adding some per-oxide of lead—which does not dissolve in the concentrated acid. It will be, however, reproduced, turning the acid yellow as before, if the bottles be exposed to light.

It is not generally known that the action of nitric acid is very greatly modified by the presence of hyponitric and nitrous acids.

Other impurities are *chlorine* or *muriatic acid*, derived from the common salt existing as an impurity in nitrate of soda. To detect it, dilute the sample with two or three times its bulk of distilled water, and add a solution of nitrate of silver. If it be present, a white curdy precipitate will fall.

Sulphuric acid may be present, either accidentally, from the employment of too high a temperature in making the acid; or purposely to raise the specific gravity. To detect it, dilute with distilled water, and drop in a solution of the nitrate of baryta. If any sulphuric acid is present, a white powdery precipitate, insoluble in acids, will subside. Or a portion of the suspected acid may be gently heated in a capsule. If the nitric acid is genuine, it will evaporate entirely away, leaving no residue. But if sulphuric acid have been added, there will remain a liquid residue, which does not fly off till the temperature is raised, and then escapes, forming dense white vapours.

Nitrate of soda is occasionally added to impart to the acid a false appearance of strength upon the hydrometer. This is readily detected by evaporating a portion to dryness, when nitrate of soda, or any other solid matter remains behind, and may be weighed.

In single aqua-fortis for dissolving tin, a certain amount of muriatic acid is necessary.

For methods of estimating the actual strength of a sample of nitric acid see ACIDIMETRY.

An excellent test to detect the presence of nitric acid in any liquid is as follows. First pour into a test-glass 1 centimetre of pure concentrated sulphuric acid. Add, drop by drop, $\frac{1}{2}$ cubic centimetre of a solution of sulphate of aniline (prepared by adding 10 drops of common aniline to 50 cubic centimetres of sulphuric acid, diluted in the proportion of 1 to 6). A glass rod is dipped into the liquor to be tested, and then into the mixture in the test-glass, in which red streaks will appear if nitric acid be present.

Or, boil the liquid under examination with clean shavings of lead for a few minutes. Mix a few drops of a weak solution of iodide of potassium with some starch paste, and add a little hydrochloric acid of specific gravity 1·006. Add to the liquid to be tested, if alkaline, a little hydrochloric acid and then pour it into the test-mixture. If nitric acid is present a violet colour will appear in course of time.

The iodide of potassium used must be perfectly free from iodate.

The uses of nitric acid in the preparation of colours and mordants, are numerous and varied. Its direct employments in dye and print works are less numerous, though it serves for the pro-

duction of a peculiar yellow upon silk, and for modifying the tone of madder reds.

TABLE

Showing the quantity of Real or Anhydrous Nitric Acid (NO_5) *in* 100 *parts of Liquid Acid, of different Specific Gravities* (*Ure*).

Specific Gravity.	Real acid in 100 parts of the Liquid.	Specific Gravity.	Real acid in 100 parts of the Liquid.	Specific Gravity.	Real acid in 100 parts of the Liquid.
1·5000	79·700	1·4600	68·542	1·4065	57·384
1·4980	78·903	1·4570	67·745	1·4023	56·587
1·4960	78·106	1·4530	66·948	1·3978	55·790
1·4940	77·309	1·4500	66·155	1·3945	54·993
1·4910	76·512	1·4460	65·354	1·3882	54·196
1·4880	75·715	1·4424	64·557	1·3833	53·399
1·4850	74·918	1·4385	63·760	1·3783	52·602
1·4820	74·121	1·4346	62·963	1·3732	51·805
1·4790	73·324	1·4306	62·166	1·3681	51·068
1·4760	72·527	1·4269	61·369	1·3630	50·211
1·4730	71·730	1·4228	60·572	1·3579	49·414
1·4700	70·933	1·4189	59·775	1·3529	48·617
1·4670	70·136	1·4147	58·978	1·3477	47·820
1·4640	69·339	1·4107	58·181	1·3427	47·023

Iron, Nitrate.—Under this name are included a great variety of preparations, some of which contain nitric as their only acid; others nitric and sulphuric, in very various proportions; and others again a mixture of nitric, sulphuric, and acetic. Some are perfect per-salts of iron, but the majority contain proto-salts in larger or smaller amount. Some are made from scrap iron, some from copperas, and some from a mixture of the two. Some are prepared from pre-existing nitric acid (single or double aqua-fortis) whilst in others the iron is dissolved by nascent nitric acid liberated during the process by the action of sulphuric acid upon nitrate of soda. In strength, too, they vary from 40° Twaddle to upwards of 100° Tw.

Yet so many and various are the purposes to which nitrate of iron is applied, that any one of these varieties may in its own place, and for its own purpose, be pronounced of good quality.

We have, in the first place, "blue irons," such as serve for

printing or dyeing blues upon silk or cotton, with the aid of prussiate of potash. Blue irons should be sharper than irons for other purposes; if too "dead," that is, if the amount of iron be too great in proportion to the acid, a part of the Prussian blue formed will be deposited at the bottom of the dye-pan, and that which is fixed upon the goods will be dull, loose, and cloudy. Nevertheless, the nitrate of iron must not be too raw; if so, the colour will be thin and hungry, and the goods will be damaged by the free acid.

If the article to be dyed be silk or cotton skeins, a blue iron made from copperas, and approaching very nearly to a pure persalt of iron, will give results superior to those obtained from a true nitrate, from aqua-fortis, and scrap iron. If piece goods with a cotton warp are to be dyed, the wool or worsted having first received its proper colour from one of the aniline blues, a blue iron made from copperas is not admissible, as it somewhat stains the worsted. If the shade required be a sky, or if it be for conversion into a green by the application of a yellow, a blue iron from hoop iron dissolved in nitric acid is advisable. But if a true royal blue is desired of a warm, bloomy tone, the best nitrate of iron is that prepared with nitrate of soda and sulphuric acid.

Black irons, or those used for printing or dyeing blacks upon silk, wool, or cotton, in conjunction with galls, myrobalans, logwood, or some other ware containing tannin, require a different preparation. Thorough saturation is here of great importance, as raw acid tells a fearful tale both upon the goods and the colours. Yet there must not be more iron present than can exist in a true state of solution, and delivered in a regular manner to the fabric. If this limit be over-stepped, the blacks will not only be uneven and blotchy, but they will, in all probability, be streaked and clouded with rust marks, where oxide of iron has been deposited upon the fibres without having combined with the tannin. Under most circumstances irons made from copperas are decidedly preferable to those made from the metal for black purposes. Nor is it essential that all the iron should be in a state of perfect peroxide. On the contrary, both theory and practice show that a fuller and bloomier black can be dyed with a nitrate of iron containing a proportion of protoxide. If the protoxide be too small in amount, the black produced will be brownish; if too large it will have too blue a tone.

In some cases a quantity of brown sugar of lead is added to

black nitrate of iron. By this means a portion of the sulphuric acid derived from the copperas is removed, forming an insoluble combination with the lead, which gives up acetic acid to take its place.

The most difficult variety of nitrate of iron to prepare successfully is "burling iron." (See BURLING INKS.) It is used to dye the spots of cotton remaining uncoloured in black woollen cloth. The margin here is exceedingly narrow; a very slight excess of acid will damage the colours on the wool; and, similarly, a slight excess of iron will inevitably disfigure the pieces with rusty blotches.

A nice balance must likewise be preserved in irons for printing purposes. If too raw and acid, the doctors and copper cylinders of the printing machines are damaged, often to a serious extent. The finished goods also not being subject to a final rinsing off as in dyeing, are very apt to be corroded in holes. The greatest freedom from corrosiveness is required when unwoven cotton warps are printed.

A third class of nitrates of iron are the "common" or "saddening," such namely as are used in drabs, browns, clarets, etc.

These require to be rather sharper than the black qualities, so that the combination they form with the sumac or galls, etc., may be faster, and able the better to withstand subsequent treatment with alum or preparations of tin. They should be as nearly as possible perfect persalts of iron, and may be made either totally from copperas, or may contain a mixture of such and of metallic iron.

Muriatic acid should never be added in the manufacture of nitrate of iron. The nitric acid used should be free from this impurity, and the nitrate of soda should be purified from chloride of sodium as far as possible. The reason is not merely that muriatic acid retains the iron it has taken up more tenaciously than nitric acid, but that, in dyeing mixed goods, it delivers the iron upon the worsted instead of upon the cotton.

For the examination of samples of nitrate of iron, the following directions may be given. Dilute with distilled water, adding sufficient pure hydrochloric acid to prevent subsalts of iron from being thrown down, then add a solution of chloride of barium. A white precipitate shows the presence of *sulphuric acid* either added as such or in the form of *copperas*.

Add to a small portion of the sample pure ammonia, till all

the oxide of iron has been precipitated. This is then filtered off, and the clear liquor evaporated down to dryness, and the residue heated to redness in a small platinum capsule. If any fixed matter remains, the sample has been got up with *nitrate of soda.*

For the detection of *alumina,* an objectionable impurity, see COPPERAS.

Dilute a portion with distilled water, add a little pure nitric acid to prevent turbidity, and then add a solution of nitrate of silver. A white curdy precipitate indicates the presence of *muriatic acid.*

To ascertain whether any portion of the iron is in the state of protoxide, drop in cautiously a solution of carbonate of soda. If the sample be a pure peroxide, the precipitate will be of a uniform pale yellow. If any protoxide be present, clouds of a greenish colour appear in the liquid. Or a dilute solution of the red prussiate of potash may be added, which, if any protoxide exist in the sample, will give a blue precipitate.

To find the comparative acidity of two samples of nitrate of iron, measure off equal volumes of each, and drop carefully into each of them, from a pourette, a standard solution of carbonate of soda, till the exact point is reached, when the liquid no longer reddens blue litmus paper. The number of degrees of the pourette consumed in each case will show the relative acidity of the samples.

Of course, only samples which mark the same specific gravity or degree on the hydrometer are thus comparable. If they differ, the stronger must be let down with water to the same degree as the weaker, and equal measures of each are then taken.

The brightness, fastness, and evenness of the shades given by different samples can only be judged by dyeing swatches of calico, or skeins of cotton.

For blue irons, equal weights of perfectly clean calico are steeped in equal measures of the samples under comparison, each previously diluted with an equal quantity of cold water for equal times. They are then lifted, allowed to drain, and steeped for equal times in equal measures of water, to each of which an equal quantity of a solution of prussiate of potash is added. The swatches are then lifted, rinsed, dried, and compared.

Black irons are tried as directed under DIVI-DIVI, preparing the swatches with some astringent, and then steeping them in the respective samples of nitrate of iron under examination.

Saddening irons may also be tried in precisely the same manner, only after being taken out of the iron liquor the swatches are each steeped in a solution of alum. That which, after this treatment looks fullest and brightest receiving the preference.

Nitrate of Lead.—Litharge or metallic lead dissolved up to perfect saturation in nitric acid, forms nitrate of lead. It forms very hard white crystals, which do not attract moisture from the air. It dissolves in twice its weight of water at 63° Fahr., the solution marking 79° Tw.

If a little solution of yellow prussiate of potash be added, the precipitate formed should be a perfect white, without the slightest tint of blue, which would indicate the presence of iron; or of brown, which would betray copper. These impurities, when present, are of small amount, and are never intentionally added.

Nitrate of lead is employed for chrome oranges and yellows upon cotton, for murexide colours, as also for preparing nitrate of copper by double decomposition.

Nona.—The root of a plant of the madder family, used for similar purposes in India, but not met with in European markets.

Nopal.—The plant called by botanists *Cactus cochenillifer*, important as being the food of the cochineal insect. All the very numerous species of cactus produce vividly scarlet, crimson, or rose-coloured blossoms, and it is hence a disputed point whether the colouring matter of cochineal pre-exists in the plant and is merely collected by the insect, or whether it is elaborated by the latter from its elements. If the former opinion be correct the question immediately arises whether it would not be practicable to dispense with the insect and obtain the colour at once from the cactus. A bright red colouring matter named *cactin* has been extracted by Vogel from cactus blossoms, but its identity with carminic acid is still questionable.

Nux Vomica.—The seeds of *Strychnos nux-vomica* and *S. colubrina*. They are flat, circular, button-like discs, rather thickened at the edges, of a pale yellowish grey or drab colour, and intensely bitter taste.

I notice them here merely because they are often found mixed with myrobalans as imported, to which, when ground, they impart an exceedingly bitter taste.

Strychnia, the bitter principle of these nuts, may be made to yield a series of colours analogous to, if not absolutely identical with those obtained from aniline.

The scarcity of the material, of course, deprives these colours of even the slightest practical value.

Oils and Fats.—We speak in this paragraph merely of the fixed or fatty oils, which do not evaporate at ordinary temperatures and leave permanent grease spots upon paper. The distinction popularly made between "oils" and "fats" is perfectly arbitrary, and depends merely upon climate. Palm oil is liquid on the Guinea coast, but in England it is a solid.

The distinction between "drying" and "non-drying" oils is highly important as regards their chemical character and their uses. The drying oils when exposed to the air, especially in thin films, take up oxygen from the air, and become converted into a hard resinous body which ultimately dries up altogether. As familiar examples I may mention poppy, nut, and linseed oil. The non-drying oils take up oxygen also, but show no disposition to solidify. If the exposure be prolonged they generally turn rancid, acquiring an offensive smell and taste. Rape, olive, and palm oil, are good examples of non-drying oils.

A considerable amount of adulteration prevails in the oil trade, valuable kinds being extensively adulterated with inferior qualities. These frauds can only be detected by chemical analysis. The very fact of their extensive existence proves that they cannot be discovered by smell, taste, touch, or any other "rule of thumb" procedure. The first point to be attended to is the specific gravity, which is best taken with an instrument specially graduated for the purpose, and styled an oleometer. The degrees run from 22° to 50°, the heavier oils corresponding to the lower degrees. As the density of oils is much more modified by temperature than that of inorganic fluids, a small and delicate thermometer, on which 0° is equal to 60° Fahr. is inserted in the stem of the instrument. In pure rape and olive oils the oleometer marks 37° or 38°; in poppy oil, 32° to 33°; camelina, 31° to 32°; and linseed, 29° to 30°. If the temperature marked on the inclosed thermometer is above 0°, it is subtracted from the degree shown on the

oleometer scale, but if below it is added. The specific gravities of the principal oils at 60° Fahr. are:—

Tallow Oil	0 900	Poppy	0·924
Rape	0·913	Camelina	0·925
Olive	0·917	Hemp	0·926
Train	0·923	Almond	0·932
Cod	0·923	Linseed	0·934
Nut	0·923		

Castor oil is still heavier, going beyond the range of the oleometer. From its high price it is never added to other oils.

The following additional tests are important. Rape, camelina, colza, and mustard, may be detected in olive oil down even to 1 per cent. as follows:—Boil in a porcelain capsule 400 to 500 grs. of the sample along with 30 grs. of *pure* soda dissolved in 300 grs. of distilled water. After the mixture has boiled a few minutes it is thrown upon a filter previously moistened, and the liquid that flows through is tested with a solution of the subacetate of lead. If this is blackened, one of the above oils is present in the sample.

The fish oils may to a very considerable extent be detected by their offensive smell when heated. They are also blackened if chlorine gas is passed into them. No such change takes place with the other animal oils, or with lard.

The following reactions are also characteristic. Caustic soda, at 70° Tw., added to 5 times its measure of sperm oil gives a dark red colour. Poppy oil gives an intense rose coloured mass if first mixed with 1-5th its bulk of an *aqua-regia*, made by mixing 25 measures of muriatic acid, at 30° Tw., with 1 measure of nitric at 65° Tw. In this the oil is allowed to stand for 5 minutes. Twice as much caustic soda as oil, at 70° Tw., is then added.

The most characteristic reactions of the different oils are the so-called "cohesion figures" recently studied by Messrs. Tomlinson and Moffatt. The method of procedure is as follows:—A perfectly clean soup-plate is filled with clean cold water, a small dry pipette drawn out to a fine point, is filled up to a fixed height with a pure sample of the oil in question, and a drop is allowed to fall upon the surface. A drop of the sample under examination is now allowed to fall in a similar manner upon the surface of water in another plate, and the figures or patterns produced on the surface are compared.

To get satisfactory results the following points must be attended to:—The plates and water must be perfectly clean, and

the latter cold. There must be no shaking, or currents of air that could communicate even the slightest motion or vibration to the water. The drop of oil in each case must be alike in size, and must be let fall from the same height, say 4 inches, upon the surface of the water, in the middle of the plate. If these precautions are observed, a genuine sample of any particular oil will always give the same pattern.

The principal oils are—

Cocoa-nut oil.—This is solid at the ordinary temperature of cold climates. It is of an exceedingly emollient nature, a property shared by soaps made from it, which leave animal fibre in a kindlier state than any other oil.

Palm oil.—Likewise solid in cold climates. It has a yellow colour which is easily removed. It can be readily saponified and yields excellent soaps for manufacturing purposes. Being the cheapest solid fat in the market it is not often adulterated, but is frequently contaminated with sand, fragments of wood and bark, arising from careless preparation. From these it can be easily freed by passing it through a cloth when melted.

Lard is too expensive for ordinary manufacturing purposes, though it is employed in some lubricating compounds. It is adulterated with farina, which is detected by rubbing a portion with iodine. If farina is present it will be blackened. A large quantity of water is also sometimes added; to detect this a weighed quantity of lard is exposed to a heat of 212° Fahr. for some time and the loss is noted. Mineral impurities may be detected by burning a small quantity of the sample in a platinum crucible.

Tallow is the most generally used of the fats. It is the hardest and can be made to yield whiter soaps than any other fat. They are, however, by no means as emollient as those made from palm, cocoa-nut, and olive oils.

Olive oil.—The inferior quality known in commerce as Gallipoli is very largely used in manufactures. It should be of a yellowish grey colour, clear, free from all rancidity of taste or smell. It yields very valuable soaps, though when employed without any admixture of other oils, the result is too hard for most purposes. It is used in Turkey-red dyeing, for which purpose it must have the property of forming with a dilute solution of pearlash a milky emulsion. It is also used in mixing certain colours.

Rape oil approaches olive in some of its properties, and is often

mixed with it. Its smell and taste, even when perfectly free from rancidity are disagreeable. Its specific gravity very nearly approaches that of olive oil; it saponifies more readily, yielding a softer soap. It is largely used as a lubricant in the woollen manufacture, though on the continent olive oil is preferred. The oils of camelina, colza, mustard, and other cruciferous plants are very similar in their nature to rape.

Tallow oil, known also as oleic acid and oleine (incorrectly oilic acid and oiline), is used in soap-making and as a lubricant.

The use of the drying oils in the tinctorial arts, either direct or indirect is very limited. *Linseed oil* may be applied in colour-mixing for the same purposes as Gallipoli. Along with *nut* and *poppy* oils it is also, to a limited extent, employed in the pigment style in calico printing, the difficulties in which are being gradually overcome.

Resin, Pine, or Vegetable oil, from its low price, is now very frequently used for mixing with more valuable oils. It has a muddy opalescent appearance; by transmitted light its colour is reddish-brown, but by reflected light it has a lilac, sometimes even a bluish plum colour. Its smell and taste are strong and peculiar, totally unlike any of the natural expressed oils, and may serve to detect it except present in very small proportions. It is heavier than the true oils, ranging up to 0·99, and going beyond the range of the oleometer, but from its viscid, varnish-like nature, its density cannot well be taken with any instrument acting upon the principle of the hydrometer.

It is not applicable to any purpose in the tinctorial arts, beyond lubricating machinery.

A kind of grease is now extensively made from waste soap lyes. It is soft, smeary, of very offensive smell and taste, and of a blackish-brown colour. It is used in making soaps of a low quality, and by stuff-dyers for crabbing or cleansing the pieces preparatory to dyeing, along with carbonate of soda and ammonia.

Oils as Mordants.—In one department of cotton-dyeing, the Turkey-red process, oil serves as an assistant mordant, and cannot so far be dispensed with, although the rationale of its action has not been discovered. The kind of oil used for this purpose is Gallipoli, which, to be fit for this use, must be capable of forming an emulsion or milky fluid when agitated with a weak solution of

pearlashes. The oil should not begin to separate out from this emulsion for a period of at least 24 hours.

Opal Blue.—A blue colour prepared from aniline, and differing from the ordinary kinds such as "regina blue," and "Bleu de Lyons," in being thoroughly freed from all traces of red and violet colour. Its name is therefore exceedingly inappropriate.

Opal blue is insoluble in water either cold or hot, but dissolves in alcohol and methylic spirit, though less freely than the impure blues. A small amount of sulphuric acid, which should be free from lead and from nitrogen compounds, promotes solution, and enables it to dye faster and brighter shades.

The alcoholic solution of the colour is added to water in the dye-bath, and gives very pure and beautiful blues upon wool and silk. For cotton it has no affinity except an animal mordant has been applied.

To judge of the quality of opal blues, it is sufficient to place a drop of the solution upon a piece of white blotting-paper, and examine the spot produced. If this be a pure, uniform blue, free alike from greenish or violet zones, the colour is good. If it show a greenish reflection, or exhibit a reddish or violet margin it is not sufficiently purified.

Orchella Weeds.—A class of lichens used in the manufacture of archil, cudbear, and their kindred colours.

The so-called Lima weed generally commands the highest price, though excellent archil is obtainable from the Bombay and Zanguebar qualities. As a general rule, weeds from maritime rocks are decidedly preferable to such as are obtained from inland districts.

The only available method of testing the quality of samples of weed is to steep a portion, previously cut and bruised, in ammonia for a few days, frequently stirring the mixture.

It is a remarkable fact that the deep and richly coloured lichens—of which there are many species—cannot be made to yield any dye of value.

To determine the amount of colouring matter in weed, digest 100 grains of the sample in a dilute solution of caustic soda repeating this operation till every trace of useful matter is extracted. The liquids obtained are mixed and filtered.

Meantime, prepare a solution of the hypochlorite of soda

(chloride of soda or bleaching-soda) of known strength, and drop this from a pourette into the liquor as long as a transient red colour is produced. The amount of the test-liquor consumed by each sample will show its relative value.

Orcin.—A crystalline body obtained from orchella weeds, and produced by the decomposition of erythric acid. It forms regular four-sided prisms, soluble in water and alcohol, and having a sweet taste. The aqueous solution readily dissolves magenta. In contact with air, water, and ammonia, it is transformed into *orceine*, a violet colouring matter known in an impure state as orchil paste, liquor, etc., and constituting also the colour of cudbear.

Orpiment.—(*Tersulphide of Arsenic.*)—A compound of arsenic and sulphur used in calico printing as a reducing agent in conjunction with indigo. It is much less employed than formerly.

Oxalate of Tin.—The trade-name applied to a variety of preparations. Some of these contain oxalic acid in quantity, some a mere trace, and some none at all. Hydrochloric and sulphuric acids, and protoxide of tin, are always present.

These compounds are very largely used in woollen dyeing. They serve for giving a surface bloom to chrome-blacks, rendering the colour at the same time more permanent, so that it may better pass for a woaded black. They are used for finishing lac and grain scarlets, crimsons, oranges, etc., and by some dyers are employed without the previous use of "scarlet spirits."

Oxalic Acid.—This powerful acid occurs naturally, combined chiefly with potash, in the juices of certain plants of the genera *Oxalis* and *Rumex*.

Artificially it was obtained by the action of nitric acid upon sugar and starch, but has latterly been prepared by treating sawdust or spent dye-woods with alkalies.

Oxalic acid when pure forms colourless transparent prismatic crystals, which have the specific gravity 1·64; are inodorous, intensely and unpleasantly sour, and do not grow moist on exposure. If they become damp, some nitric or sulphuric acid used in its preparation has not been thoroughly removed. It is

soluble in its own weight of boiling water, but requires eight times its weight of water at 60° Fahr.

To detect sulphuric acid, dissolve in pure water, and add first pure hydrochloric acid, and then chloride of barium. If the oxalic acid is pure, the liquid will remain clear, but if there be an impurity of sulphuric acid a white turbidity will appear.

To detect *organic impurities*, heat a portion with concentrated sulphuric acid. If any such matter be present the sample will turn brown or black.

If the smallest trace of *nitric acid* be present, a small quantity of the extract of indigo, boiled along with the solution of the sample will have its colour destroyed.

If *lime*, *potash*, or *soda* be present, a portion of the acid, heated to redness, will leave a fixed residue.

In dyeing, oxalic acid is used to give fire to cochineal and lac colours, especially scarlets and oranges. It also gives a bloom and richness to royal blues upon wool and worsted which cannot be otherwise produced. It is useful for removing spots and stains, especially the rust of iron. Great care is required in its use or the goods will be injured in their texture.

In printing it serves for a discharge in certain cases.

Oxygen.—A colourless, tasteless, and inodorous gas, forming, it is calculated, one-third part of the entire earth. Water contains it in the proportion of 89, and air of 23 per cent.

Its presence in the air, of which it may be styled the active principle, is the cause of those natural processes known as combustion and decay. It has a powerful affinity for most of the other elements, combining with all except fluorine, in many cases in more than one proportion, and forming very important compounds. With the non-metallic bodies, such as sulphur, phosphorus, carbon, etc., and also with certain metals such as arsenic, antimony and manganese, it forms acids; whilst with the majority of metals such as sodium, calcium, zinc, and silver, it forms oxides of basic properties able to combine with the acids.

Upon organic matter it produces also important changes. Many colours, such as indigo-blue, magenta, etc., are formed by the influence of oxidizing agents, and can be decolourized by a process of reduction. On the other hand by the prolonged action of oxygen most colours are gradually destroyed. Bleaching, as effected by exposure to the atmosphere, or by a solution of

bleaching-lime, appears to depend on the destruction of colouring matters by oxidation.

Like other elements, oxygen is most active and powerful in what is called the *nascent state*, that is, in the instant of its liberation from some other compound. The principal oxidizing agents are bodies such as binoxides of barium, or of hydrogen, nitric, chromic, permanganic, and chloric acids, etc. Bodies placed in contact with these undergo changes which mere exposure to oxygen gas would not produce.

Ozone.—A gaseous substance found in the atmosphere, and first discovered by Schoenbein. Concerning its constitution, authorities are not quite unanimous. It has been regarded as binoxide of hydrogen, either in its ordinary condition, or in an allotropic state, or as a teroxide of hydrogen. Most chemists at present view it as merely oxygen in a state in which its properties are exalted or intensified in some unknown manner.

It exerts a most powerful oxidizing action, bleaching colours, decomposing miasmata, etc. It is generally detected by means of slips of paper coated with starch, and dipped in a solution of the iodide of potassium. Ozone, if present, decomposes this salt, liberating iodine, which re-acting upon the starch, colours it a blue-black, varying in intensity according to the amount of ozone present. It is remarkable that ozone is much more plentiful in the atmosphere during southerly and westerly winds than during a northerly or easterly current. There can be no doubt that had we a means of preparing ozone cheaply, it would find abundant and most important applications in the arts. The present process for its preparation, *i.e.* exposing sticks of phosphorus to the air in bottles containing a small quantity of water is tedious, expensive, and if attempted on a large scale would be dangerous. It is also formed during the slow oxidation of ether.

Panama Bark.—The bark of *Quillaja saponaria*, a tree found in Central America.

It occurs in commerce in flattish pieces, and fragments of a yellowish grey colour, darker and smooth on the outside, and paler next the wood. It easily breaks and splits up into thin layers which exhibit a curious twisting and crossing of fibre.

If chewed, and the juice swallowed, it has a most irritating

effect upon the the throat. A similar result is produced by the dust if inhaled.

The decoction in water is of a faint orange brown colour, neutral to litmus-paper.

With nitrate of iron it darkens and gives a blackish precipitate, the colour above being brown. With bichromate of potash the liquid darkens to a deep red brown, but there is no precipitate. With salts of lead grey precipitates are formed, the liquid above being colourless. The per and protochlorides of tin, on standing, both give fawn coloured precipitates. Chloride of zinc gives a deep blue-grey precipitate, the supernatant liquor being nearly colourless.

By the natives of the country where it grows, Panama bark is used as a substitute for soap. In the tinctorial arts it serves in the form of decoction—First, to prevent aniline colours from flushing or bronzing on the surface of the goods, rendering them solid and level, and controlling the tendency of the colours to curdle and fall to the bottom.

Second. Goods that have become flushed can frequently be cleared by working or wincing in a decoction of the bark.

Third. It serves either along with or after soap, to prepare goods for receiving the brighest and most delicate colours, producing a clearer and more brilliant surface than can be produced by the best soaps alone, and this without rendering the texture harsh.

Its uses in dyeing and printing will be extended.

Pawlownic Acid.—A crystalline yellow colouring matter obtained from the fruit capsules of *Pawlownia imperialis*. It does not exhibit any practical value.

Peachwood.—One of the commonest varieties of the soft red woods. It is, strictly speaking, the produce of a species of *Cæsalpinia* growing in Campeachy, of which its name is a corruption ; but soft red woods from other localities are included by dyers under the same name. In its chemical and tinctorial properties it agrees with BRAZIL WOOD.

Persian Berries, known also as *French, Avignon, and Turkey Berries.*—These berries are the fruit of *Rhamnus infectorius*, the dyer's buckthorn, a small tree which grows in France, Spain, the Mediterranean Islands, and Turkey, both European and Asiatic. The quality of the berries differs considerably according to the

locality where they are grown. Some of the berries are large and greenish, whilst others are smaller, brown and wrinkled, the colouring principle in these two kinds being distinct.

The colour of the former is known as *rhamnein* or *chrysorhamnin*. This principle is soluble in alcohol, but very sparingly soluble in cold water. In boiling water it dissolves readily, and is converted into *xanthorhamnin*, the colour naturally occurring in berries of the brown kind.

Phenicienne.—An artificial colouring matter discovered in 1863, by Roth. It is derived from phenol by submitting it to the action of a mixture of nitric and sulphuric acids. It produces a series of shades ranging from a golden buff to a garnet red, which have the advantage of being permanent. It will undoubtedly prove very useful when fairly brought forward. It is known also as "Phenyl brown," and as "Rotheine." It must not be confounded with Bismark brown.

Phosphoric Acid.—Phosphoric acid and its salts, the phosphates, have not hitherto received any very extended application in dyeing and printing. Phosphoric acid has been occasionally employed in some of the many substitutes for tartaric acid and tartar, which have latterly made their appearance. Phosphate of soda has been used in dung substitutes.

The attempts to utilize the reducing power of phosphuretted hydrogen gas in producing metallic effects upon textile fabrics have been hitherto unsuccessful, from the irregular and unmanageable character of the agent employed.

Picramic Acid.—A derivation of picric acid obtained by the action of reducing agents. It dyes a fine and permanent brown, but is so far little in use.

Picric Acid, called also *Carbazotic Acid.*—A bright yellow crystalline body first obtained by the action of strong nitric acid upon indigo. It has subsequently been obtained by the action of the same acid upon silk waste, upon leather clippings, upon crude coal tar, and upon the resin of *Xanthorrea hastilis*, known as yellow Australian gum. It is at present manufactured from crystallized carbolic acid.

When pure it is of a very pale yellow; of an intense and persistent bitter taste. It dissolves readily in water, and is also soluble in benzole, and in twenty times its weight of ether. Benzole may be used as a test for the purity of commercial samples. If these are adulterated with borax, oxalic acid, sulphate of soda, etc., the impurities remain behind, whilst the picric acid is readily taken up.

The compounds of picric acid with the alkalies and other bases are powerfully explosive.

Its tinctorial power is very great, and its affinity for wool and silk is strong, but it does not attach itself to cotton in the slightest degree.

The presence of a trace of sulphuric acid enables it to dye brighter and more permanent shades.

It is now very extensively used both for yellows and greens, especially the night-greens, which if too blue, are brought to the exact shade required by its use.

It is also emplyed as the source of PICRAMIC and ISOPURPURIC Acids.

Pink Salt (*Double Chloride of Tin and Ammonium*).—This salt is a compound of bichloride of tin (perchloride) and of sal-ammoniac or chloride of ammonium. It contains when pure 70 parts of bichloride of tin to 30 of sal-ammoniac. It is soluble in three times its weight of water, at 60° Fahr. If boiled in the state of a concentrated solution, it is not decomposed, but if dilute, the whole of the tin is deposited in the form of flakes of oxide.

It is very valuable as a solvent for organic colouring matters, and its uses both in printing and dyeing are likely to increase the more these arts are followed in a scientific manner.

Pittacal.—A little known body obtained during the destructive distillation of wood. It has a fine deep blue colour, assuming under the burnisher a fine golden lustre. It is reddened by acids. It has not yet been introduced as a commercial product.

Pomegranate Husks.—The husk or rind of the pomegranate fruit, though very rarely used in England, is a valuable astringent, containing about 32 per cent. of tannin of a fine quality. The blacks which it yields with iron have a peculiar softness and richness of colour. In Spain it is preferred to sumac.

Potash, Bichromate, otherwise known as *Red Chrome and Bichrome.*—This salt consists of one equivalent of potash, combined with two equivalents of chromic acid. It contains no water of crystallization, and consequently cannot lose weight by exposure to heat or dry air. It is not deliquescent, attracting no moisture from a damp atmosphere. It dissolves in ten times its weight of cold water, and is insoluble in alcohol. It forms bright red crystals, which, when powdered, take a more yellowish colour. The solution is of a deep orange-yellow.

Good bichrome is found in clear well-defined crystals, without any whitish or yellowish spots or incrustations. It should dissolve entirely in pure water, leaving no sediment or residue. If dissolved in distilled water, acidified with nitric acid, the solution, on the addition of nitrate of baryta, should not give a precipitate. If one appears, it denotes the presence of sulphuric acid, present as sulphate of potash.

The bichrome of commerce, generally speaking, varies exceedingly little in composition, and makes a near approach to a state of chemical purity.

Bichromate of potash is a powerful oxidizing agent, and produces very complex and interesting changes in tinctorial bodies. It is an intense poison, and acts deleteriously not merely when swallowed, but also when allowed to remain much or long in contact with the skin. The hands of dyers who work much with this salt, become swollen and ulcerated, and in time the mischief extends to the toes, palate, jaw-bones, etc.

Its most extensive application is now in the production of black shades upon woollen and worsted goods, along with logwood. The chrome blacks are cheap from the low price of the materials, and can be dyed much more rapidly than the logwood and copperas blacks. On the other hand, they are less permanent. The best chrome blacks, upon prolonged exposure to air and light—espcially direct sunshine—exhibit a greenish reflection, which becomes more decided in time. This change is due to the gradual reduction of the chromic acid, which passes to the state of green sesquioxide of chromium.

Bichrome is also extensively used, both in dyeing and printing, for yellows and oranges, along with various preparations of lead. These colours are adapted for cotton, but have the disadvantage of turning black wherever exposed to the fumes of decomposing organic matter.

Potash, Chlorate.—A very powerful oxidizing agent, sometimes used in calico-printing, and in the preparation of colours. It should be found in clear, colourless crystals, sparingly soluble in water. The solution should yield no precipitate with a dilute solution of the nitrate of silver. Care should be taken never to bring large quantities of this salt in contact with strong acids.

Potash, Chromate of.—(*Yellow Chrome or Neutral Chrome.*) —This salt differs from bichrome in containing only one equivalent of chromic acid. It is much more soluble than the bichromate, but does not attract moisture from the air, except it contains some carbonate of potash as an impurity, which is very often the case. It is sometimes met with in crystals, but more frequently in soft irregular crusts and masses.

In its action upon organic colouring matters, it is milder and more easily regulated than bichrome, and produces some totally distinct results.

Nevertheless, it is little used by dyers and printers, from the reason that two samples are rarely found alike, and the effects produced exhibit, of course, a corresponding irregularity.

The impurities found in yellow chrome, are carbonate of potash, as above mentioned, and sulphate of potash. The latter is sometimes present to the extent of 56 per cent. It may be detected by dissolving in pure water, and adding first a little nitric acid, and then some solution of nitrate of baryta. A white precipitate shows the presence of sulphate of potash.

The double chromate of potash and soda, a salt which exactly agrees in its properties with neutral chromate of potash, may be easily and safely made, by adding to 151 parts of bichrome, 143 parts of good clean soda crystals, which must not be effloresced, or dried in.

Potash, Prussiate.—This important salt has many names, such as yellow prussiate, ferrocyanuret of potash, blood-salt, etc. Its strictly scientific name is, at present, ferrocyanide of potassium.

It forms large fine crystals of a lemon, or rather amber-yellow colour. In the superior qualities, the shade inclines rather to the orange, and in inferior to the greenish side.

It is generally met with pure. The chief contamination to which it is liable, is sulphate of potash, when the mother-liquor

has not been perfectly removed by crystallization. To detect this, a small portion is dissolved in water, mixed with a very little pure hydrochloric acid, and then with a few drops of a solution of chloride of barium. If sulphate of potash be present, a white turbidity will appear in the liquid, which will soon subside to the bottom of the glass.

The value of an unknown sample of yellow prussiate may be ascertained as follows :—prepare a standard solution of pure ferrocyanide of potassium, so that 10,000 fluid grains of water may contain 200 grs. of ferrocyanide. A solution is also prepared of *pure* permanganate of potash.

100 grain measures of the standard solution of ferrocyanide, are poured into a beaker glass, standing on white paper, and 250 grain measures of water are added. The mixture is now acidified with sulphuric acid. The permanganate solution is now carefully dropped in from the pourette, till a very faint pink tinge appears in the liquid. The number of degrees of permanganate required to effect this will, of course, represent 2 grs. of perfectly pure prussiate. Two grains of the sample to be tested, are next weighed out, dissolved in 350 grain measures of water, acidified with sulphuric acid, placed in a beaker as above, and the solution of permanganate dropped in. The number of degrees consumed before the pink tinge makes its appearance will show the amount of real permanganate present in the sample.

The consumption of prussiate of potash has been greatly reduced in consequence of the introduction of the aniline blues. It is still, however, used in dyeing royal blues, gentians, etc., both on wool and cotton, and in preparing the tin-pulp for steam blues. It also serves as the material for the manufacture of "red prussiate."

Potashes.—(*Vegetable Alkali.*)—Potash occurs in the market in several states; the crude, brown Canadian, or American pot-ashes; pearlashes, which are partially refined and sometimes extensively adulterated, and salts of tartar, which are tolerably pure.

To ascertain the strength of a sample of ashes of any of these kinds, weigh out 50 grs., and proceed exactly as directed under ALKALIMETRY. It must be remembered that an acid of which 81 degrees neutralize 29·2 grs. of actual soda will saturate 44·2 of actual potash.

Pearlashes and salts of tartar—potashes more rarely—are adulterated with soda-ash, which is much cheaper. In such cases, the results obtained by saturating with a standard acid, are quite deceptive. The method of estimating the potash in such cases, is too tedious and complicated for any but professional chemists.

Potash and soda are, for many purposes, nearly identical. The greater power of the former for absorbing moisture from the atmosphere, gives it an advantage for certain purposes. It is preferred for extracting the pink colouring matter of safflower, and for dissolving annatto. Pearlash serves also to form an emulsion with the oil used in dyeing Turkey reds.

Potassium Cyanide.—This salt has as yet received a very slight application in the tinctorial arts. It is a most powerful reducing agent, and capable of discharging many aniline colours. It serves also in the preparation of the isopurpurate of potash.

Potato Leaves.—The leaves of the potato plant, after a roasting or baking process, have been used in France for thickening colours.

Prussian Blue.—This well-known pigment is of somewhat complex constitution. There are two varieties; the one, common Prussian blue, is a ferrocyanide of iron, formed by adding a solution of the yellow prussiate of potash to a persalt of iron, such as the perchloride, pernitrate, or persulphate. The other known as Turnbull's, and sometimes as Chinese blue, is a ferridcyanide of iron, and results when the red prussiate of potash is brought in contact with a protosalt of iron, such as common green copperas. Prussian blue is brighter than indigo, insoluble in water, unaffected by dilute acids, but decomposed by concentrated acids, and rapidly destroyed by alkalies, which leave a rusty brown residue. When in lumps, it exhibits a coppery reflection, which is the brighter and more intense as the quality of the colour is better. The preparation of superior Prussian blues requires attention to a variety of minute points, such as the degree of dilution of the liquids, the order in which they are brought in contact, the salts of iron selected, etc. The ordinary qualities are contaminated with alumina, which reduces the intensity of the colour, and robs it of its softness and lustre.

By a peculiar process, Prussian blue may be made perfectly soluble in water. When in this state, it may be distinguished from solutions of indigo as follows: the latter when artificial light is allowed to shine through them, appear of a reddish purple, which is not the case with soluble Prussian blue. Common Prussian blues may be dissolved by the aid of oxalic acid. These solutions are, however, imperfect, the colour being ordinarily merely held in a fine state of suspension, and being gradually decomposed.

The uses of Prussian blue in the tinctorial arts are but limited. As a pigment colour in printing, it has been superseded by artificial ultramarine; as a finishing blue, it has been used in the soluble state, but has now been abandoned in favour of the aniline blues. As a blue dye præformed, Prussian blue rendered soluble is deficient in brightness, though it is sometimes applied as a spirit colour, after being rendered soluble by chlorides of tin.

Prussiate, Red.—(*Ferridcyanide of Potassium, Ferricyanide of Potassium, Chloroprussiate.*)—This salt occurs in deep red prismatic crystals, which should be bold, clean, and free from green, grey, or brown powdery matters. It should be quite dry, losing no weight upon exposure to a heat of 212° Fahr.; it should be perfectly soluble in water, and its solution should give no blue precipitate with persalts of iron. It must, however, be remembered, that if the smallest quantity of protosalt of iron be present, a blue precipitate will appear, even with the purest samples of red prussiate.

The red prussiate is considered by some dyers, to yield richer and bloomier shades of blue, than can be obtained from yellow prussiate.

Purpuric Acid.—(Known also as "*Red Extract of Indigo,*" *Phenicin, and Sulphopurpuric Acid.*)—The ordinary extract of indigo is formed, as stated under that head, by the prolonged action of the strongest sulphuric acid upon indigo. If the quantity of acid is considerably reduced, and its time of action shortened, a different product—purpuric acid—is obtained.

It may also be obtained by fusing finely ground indigo with the bisulphate of soda.

Purpuric acid dyes richer and bloomier shades than can

be produced by the ordinary extract of indigo. Contrary, however, to what might have been theoretically anticipated, the colour is not more stable, being completely stripped by hot soap-lyes. By digestion in sulphuric acid, it is readily converted into the common extract.

Purree.—(*Indian Yellow.*)—A pigment containing magnesia and alumina, combined with an organic colouring matter of uncertain origin. It is generally said to be obtained from the urine of camels, fed upon the rind of the mangosteen.

Pyroxiline.—Commonly known as gun-cotton. When clean cotton is steeped for a short time in a mixture of concentrated nitric and sulphuric acids, and afterwards well washed in water, it undergoes a remarkable change. Instead of being destroyed as might have been expected, the fibre increases in weight, takes up the elements of nitric acid, becomes exceedingly combustible and explosive, and its affinities for colours are altered. At first they are weakened, but when the gun-cotton, by long keeping, has undergone a partial decomposition, they become stronger than in raw cotton.

According to the experiments of Kuhlmann, cotton soaked for twenty minutes in a mixture of 1 measure nitric acid, at 34° Beaume, 2 measures sulphuric acid full strength, and ½ measure water, afterwards washed in water, passed through a bath of carbonate of soda, again washed and dried, possesses an extraordinary affinity for colours, even archil and picric acid. Brazil-wood, and garancine, likewise, gave much fuller and brighter colours upon prepared cotton, than could be produced upon unprepared, with the same mordants.

It is further remarkable that animal fibres, such as silk, wool, hair and feathers, though, of course, incapable of conversion into pyroxiline, when treated with the above-mentioned mixture of acids, acquire greater affinity for colours.

Quercitron Bark.—An important yellow colouring matter, obtained from *Quercus infectoria*, a variety of oak, growing in North America. There are two varieties in the market, the Philadelphia and the Baltimore, the former being superior. It is sold ground, a mixture of dust and fibres, and is of a yellowish stone colour. Its tinctorial power is great. The colouring

matter of bark is sold also in the form of extract or liquor, of a paste, and of a powder, known as FLAVINE.

Bark is very extensively used for the yellow part of compound colours, such as scarlets, oranges, greens, drabs, olives, and blacks. It works both upon animal and vegetable fibre, its mordant for the former being salts of tin, and for the latter, alum.

Red Colours, Detection of.—The principal red colours likely to be met with upon dyed and printed goods are:—

1. Madder and its allies, such as munjeet.

This is the fastest red, not being affected by water containing 4 per cent. of hydrochloric acid or ammonia.

2. Cochineal, with lac and kermes.

These colours are turned to a more fiery shade by oxalic acid, and take a more violet hue with ammonia.

3. Safflower, carthamine.

Readily discharged by very weak soap-water.

4. Murexide, or Roman purple.

It is discharged by citric acid, and by boiling soap-lyes.

5. Magenta, fuschine, roseine, etc.

Impoverished and dulled by ammonia.

6. Coralline, or peonine.

If a portion of the cloth is soaked in hot alcohol, the colour is dissolved away, and in the liquid state is then brightened by ammonia.

7. Weed-colours, such as cudbear, archil, etc.

These are easily turned blue by alkalies, and reddened again by acids. They are destroyed by the protochloride of tin.

8. Wood-reds, from barwood, peachwood, etc.

Affected by acids and alkalies; the former turning them a more fiery, cherry, or orange hue, and the latter, a more purple tint. They are are not destroyed by protochloride of tin, like the weed-colours.

Red Liquor.—(Known also as *Red Mordant, Acetate of Alumina, Pyrolignite of Alumina, etc.*)

This very important mordant consists of acetic acid in combination with alumina. It is generally prepared by double decomposition. Some soluble acetate, generally the acetate of lead, or that of lime, is mixed in solution with alum or sulphate of alumina. The lead or lime is precipitated in combination with

the sulphuric acid whilst the alumina unites with the acetic acid, and remains in solution. The proportions employed vary exceedingly according to the views of the compounder, or the particular purpose in view. It is remarkable, but by no means unprecedented, that the best results are obtained from the use of proportions which are not exactly equivalent, and which consequently do not mutually decompose each other entirely. About three-fourths of the acetate of lead or of lime needed to produce a pure acetate of alumina are generally used. The result consequently contains a portion of undecomposed alum, or sulphate of alumina. A variety of other ingredients are occasionally added, such as carbonate of soda, crystals and chalk, common salt, acetic acid, nitrate of zinc, and acetate of copper. Chalk and carbonate of soda neutralize a part of the acid, and thus enable the alumina to be more readily deposited upon the fibre. It is difficult to see what can be the use of a salt of copper, or to look upon the addition of common salt in any other light than an adulteration.

Red liquor is generally of a yellowish or brownish colour, of a sweetish taste and a smell of wood-tar. Its strength varies from 8° to 24° Tw.

The quality of a sample, or rather its adaptability for any particular purpose is best decided by practical tests.

Red Woods.—There are two classes of red woods used in dying and printing, as well as in the manufacture of red inks and of certain pigments. Firstly we have the soft woods, whose colouring matter is easily soluble in water, and from which aqueous decoctions or extracts of various degrees of consistence can be prepared. These are all obtained from various species of the botanical genus *Cæsalpinia*. The principal species are Fernambuc wood, Brazil wood, Peach wood, Lima wood, Nicaragua wood, Santa-Martha wood, Brasiletto, and Sapan wood. All these, except the last mentioned, are obtained from South and Central America. Sapan is procured from Siam and other parts of India.

The hard red woods are of a more resinous nature, produce faster dyes, but yield their colouring matter very imperfectly to water, and cannot be used in the form of extract. They are Cam wood, Santal wood, and Barwood.

Regina Purple.—The trade-name of a peculiar kind of

aniline-violet, as prepared by heating magenta *alone* to a certain elevated temperature, when it is decomposed with separation of ammonia.

Rhubarb.—The red colouring matter of the Rhubarb-root has been elsewhere mentioned under the name of *erythrose*.

The red colour of the stalks is exceedingly fugitive and not brilliant. The leaves are coming into use in some districts in place of woad, as an adjunct to the indigo vat, where they serve to promote fermentation.

Rosaniline.—An organic base, which in combination with different acids forms the varieties of magenta, *i.e.* roseine, azaleine, fuschine, etc.

Rosaniline is formed by submitting the mixture of aniline and toluidine known as aniline-oil, to the influence of oxidizing agents at a high temperature. See MAGENTA.

Rosin.—The chief impurity in rosin is water, which at once adds to the weight and improves the colour. To detect this, an ounce of the suspected sample is exposed to a steam-heat, and the loss of weight is noted. It should be clear, free from specks and from dirt. It is chiefly used in bleaching cotton goods in the state of an imperfect soap-like compound.

Rosolic Acid.—(*Aurine.*)—An artificial colour discovered by Runge whilst investigating the constituents of coal-tar. It is now prepared by the joint action of sulphuric and oxalic acids upon carbolic acid. The first attempts to use this substance as a dye failed, because it was not sufficiently purified. It produces orange tints, bordering upon flame-colour upon silk and upon cotton with animal mordants.

Safflower.—The flower of a plant known as *Carthamus tinctorius*, and obtained in the greatest perfection from India, where it is largely cultivated.

Safflower contains two colouring matters, a yellow which is worthless, and a red, which is very fine. There is some reason for supposing that the yellow is formed at the expense of the red by the action of air and moisture, and many attempts have been

made, in consequence of this view, for reconverting the yellow into the red. Hitherto these attempts have not been successful.

The yellow matter is soluble in cold water, but very careful washing is needed for its entire removal. The red colour is found in not more than one-third the amount of the yellow, or about 0·5 per cent. It is soluble in alcohol, and in water containing a trace of an alkaline carbonate, from which it is re-precipitated by acids. Hence it is considered as a feeble acid, and has received the name carthamic acid, or CARTHAMINE.

In pure water it is insoluble; a fact upon which is founded the method employed for its separation from the yellow colour. The cakes of compressed safflower, as imported, are broken up, placed in bags, and steeped in a current of pure water till no further yellow tint is imparted to the stream. The safflower thus washed is treated in the cold with a weak solution of carbonate of potash or crystallized soda, to the extent of one gallon to each pound of safflower. In this it is soaked for about six hours with frequent and careful stirring. At the end of this time the whole is carefully strained through a fine hair cloth. The liquid which runs through contains the colour. The solid residue is well pressed, and the liquid that oozes out is added to the rest.

The carthamic acid in this state is, however, not capable of dyeing. For this purpose it requires the addition of an acid to neutralize the alkali—preferably the tartaric or citric. Oxalic acid turning the colour too much to the orange side, whilst sulphuric acid gives it a bluish tint.

With this addition the solution of colour can be immediately used for dyeing either cotton, silk, or woollen. The longer it is allowed to stand in this state the feebler its affinity for the fibre seems to become.

It is sometimes found that the colour prepared as above directed, though it dyes cotton beautifully, produces unsatisfactory shades upon silk and wool, a quantity of the yellow colouring matter being present, and attaching itself to fibres of the two latter kinds.

The presence of this residuary yellow is variously accounted for. Some assert that if the red colouring matter is kept too long in contact with a large quantity of water, especially if the temperature be high, it undergoes partial decomposition, a portion of it being converted into a yellow colour.

Others maintain that a portion of the yellow colour is combined

with the red in such a manner that it cannot be extracted by washing with pure cold water.

Without pronouncing definitely on either of these theories, I would suggest that in these cases a part of the safflower may have escaped perfect washing. The masses or cakes in which safflower arrives being very compact and very dry repel water, and without great care, some portions may escape being wetted, and if so, these will yield up their yellow colour along with the red to the alkaline solution.

When a very superior quality of colour is required for silks, some dyers first dye a quantity of very clean cotton with the colour prepared as above, wash the cotton well in pure water, and then steep it in a weak solution of pearlash. This dissolves the red colour away from the cotton, forming a liquor with which, after the addition of an acid, the silk can be dyed.

The only available method of judging of the quality of safflower is to take equal weights of the respective samples, prepare them as aforesaid, and dye equal weights of cotton with them, comparing the depth and purity of the shades produced. Safflower is not liable to adulteration; but varies much, both as to the quantity and quality of its red colouring matter.

Safflower ranks among the most fugitive of colours. It is strongly acted on by light, especially whilst the goods are still moist—by soap, and alkalies, and by acid, and sulphuretted vapours. Hence, first-rate safflower shades can be produced only where the air is pure. A current of dry, cold air in a darkened chamber is the best arrangement for drying the goods.

The use of safflower has diminished since the introduction of magenta. Yet for pinks and rose shades the finest magentas are inferior to safflower.

As in the case with many other wares, the portion of carthamine which first, and most readily, dissolves out of the safflower is by far the finest, whilst the last is much inferior.

Saffron.—The flowers of *Crocus sativus*, formerly used as a dye ware, but now rarely employed, except in colouring articles of food. Its colouring matter is insoluble in water, but dissolves readily in alcohol, and essential and fatty oils. It has received the name *polychroite*, and its composition has been a matter of dispute, but it is now considered identical with *crocin*, the colouring principle of *Gardenia grandiflora*.

Sal-ammoniac.—(*Chloride of Ammonium, Muriate of Ammonia.*)—A compound of ammonia and chlorine found in commerce either in the state of crystals, or in tough, compact, fibrous masses formed by sublimation. Sal-ammoniac is neutral to litmus paper; does not melt in the air; has a pungent taste; volatilizes when heated; dissolves in its own weight of boiling water, and in about $2\frac{1}{2}$ parts of cold. The chief impurity likely to be present is chloride of iron. It may be easily detected by adding a mixture of the solutions of red and yellow prussiate of potash to the solution of the suspected sample. A blue precipitate shows the presence of iron.

The presence of sal-ammoniac modifies the action of metallic salts upon organic colours, as may easily be seen by adding perchloride of tin and pink-salt (which is a compound of perchloride of tin and sal-ammoniac) to two portions of a solution of cochineal. It is extensively used along with salts of copper.

Common Salt.—(*Chloride of Sodium, formerly Muriate of Soda.*—The properties of common salt need no description. It is directly used in a few cases in mixing colours. Indirectly, it is of vast importance in the manufacture of muriatic acid, and soda with its salts. It also serves to precipitate certain colours from their solutions, which it effects by means of its superior attraction for water. In this manner it is useful in the purification of extract of indigo, the aniline colours, etc.

Its fraudulent uses would require a volume for their exhaustive description. It is added to the liquid and paste extracts of dyewoods, to tumeric, flavine, cudbear, dyer's spirits, soda-ash, etc., etc. In all these cases its presence is more or less injurious.

Samples, Taking.—To take a sample which shall be a perfectly fair representative of a bulk, is best accomplished on the Cornish system, which is equally applicable either to a ship's load or to a single bag or chestful, no matter how heterogeneous the mass may seem.

The bulk, if needful, is spread out in a pretty level mass of an oblong shape, and a track or channel is cut through it from end to end. This is then intersected by other cuts or channels at right angles with the first. At each point of intersection, or from each face of the compartments into which the bulk is thus divided, we take a barrowful, spadeful, scoopful, or spoonful, according to

size. These portions are next thrown all together, well mixed, and any very large lumps are broken up. This reduced quantity is now again spread out, cut, and portions taken as before. These are well mixed together, brought to a coarse uniform powder, again spread out, divided, and portions taken. These are finally mixed up and brought to a fine powder. In this manner a sample of an ounce can be obtained which fairly represents a bulk of 1000 tons.

If the bulk to be sampled is contained in casks, bags, or chests, the first spreading out is needless. A scoopful, or handful, is taken from every package. These are then mixed, and further treated as above.

If the bulk consists of particles nearly equal in size, as in case of myrobalans, cochineal, etc., no grinding or pounding need be resorted to till the final sample is obtained.

If it is impracticable to grind up the bulk, as in case of indigo, a small portion is taken off each lump or block with a rasp. The raspings are mixed together and thoroughly pulverized.

Santal Wood, known also *Sandal Wood, Saunders Wood, and Red Sanders.*—This wood is brought from India, principally from the eastern coast of Hindustan, and is the produce of a large tree known as *Pterocarpus santalinus.*

It is one of the hard red woods, yielding very little colour, even to boiling water. It contains 16 per cent. of *santaline,* a peculiar colouring matter found also in barwood, and which may be extracted by means of alcohol, or acetic acid.

Like barwood it dissolves in soda and ammonia, with a purple red colour, and may be reprecipitated from these solutions by an acid. The alcoholic extract gives lake colours similar to those yielded by the tincture of barwood.

Santal wood is usually imported in large heavy billets of a blackish-red colour. For use it must be rasped very fine, and is, when recently ground, of a red colour, but turns brownish on long exposure to the air. From cam wood, and still more from the soft red woods, santal wood is known by its very much more sparing solubility in water. From barwood it is known by its powerful and pleasant odour, barwood on the other hand being secntless.

Santal wood is employed, though not very extensively, in woollen dyeing. It yields certain browns of great permanence,

and like the other hard woods is sometimes applied to cloths which are afterwards to be dyed an indigo-blue in the vat. In other cases the indigo is applied first and then topped with santal wood. It is similarly applied along with certain aniline colours, such as "Guernsey Blue."

Sapan Wood.—One of the soft red woods, yielded by a variety of *Cæsalpinia*, growing principally in Siam and Bimas. It yields a good liquor or extract, and is on that account much used by printers. Its properties agree with those of BRAZIL WOOD.

Scarlet Spirits.—(*Bowl Spirits or Nitrate of Tin.*)—The existence of a true, permanent nitrate of tin is very questionable. Yet so-called "single aqua-fortis," *i.e.*, nitric acid at about 32° to 34° Twaddle, to which a small per centage of hydrochloric acid, or of a solution of sal-ammoniac or of common salt has been added, is capable of dissolving a considerable amount of metallic tin and of holding it in solution for some time. The liquid thus obtained contains about 2¼ ozs. of metallic tin to the pound of acid, marks from 58° to 65° Tw., and is of a clear reddish-amber colour. In cold weather it retains its transparency for months, but at higher temperatures it soon becomes milky and opaque, depositing its tin as a yellowish gelatinous mass, and becoming unfit for use.

In the preparation of this mordant and of the aqua-fortis used for that purpose, a variety of precautions are required which do not come within the plan of this work. It is especially necessary that the aqua-fortis should contain no sulphuric acid.

This spirit, as its name implies, is used in dyeing scarlets, crimsons, and other cochineal colours upon woollen and worsted goods.

Silicates, Alkaline.—The soluble silicates of potash and soda are becoming of some importance in the tinctorial arts. They are made by fusing clean quartz-sand with potash or soda respectively; or by boiling powdered quartz in caustic alkali under pressure. Both these compounds, however prepared, must be preserved from the action of the atmosphere, especially when in a state of solution, as the carbonic acid in the air combines with the alkali, and sets the silica at liberty.

The uses of these salts, especially of the SILICATE OF SODA, are various and extending. It is now employed as a useful addition to certain kinds of soaps. For the bath for dyeing Guernsey and Nicholson blues, and pomona greens, silicate of soda is a much better ingredient than either borax or the carbonate of soda. When carefully neutralized so as to be free from all excess of alkali, it is occasionally employed as a dung substitute. It is also sometimes employed for fixing pigment colours in printing, but without satisfactory results.

Silk.—A nitrogenous fibre of great importance. Unlike wool and cotton, a thread of silk appears under the microscope plain and simple, like a minute wire. It is secreted in the state of a gum or varnish by most insects during the larva period of their existence, but only by certain nocturnal lepidoptera in quantities of importance. The common silk-moth, *Bombyx mori*, has been hitherto the chief producer, though there is reason to believe that certain allied species may prove of even greater value.

Silk as imported is coated with a loose matter technically known as gum, and forming 23 to 30 per cent. of the total weight. This requires to be removed before the silk can be manufactured. This process, called ungumming, is performed in Europe by boiling the raw silk with weak soap-lye of fine quality. In China, a mixture of wheat flour, bean meal, salt and vinegar, is used. If the soap lyes be too strong, or the boiling too prolonged, a part of the silk itself is dissolved and the remainder is deteriorated. Even boiling water alone is in time capable of producing this effect. We may hence conclude that the so-called gum differs from the true silk, not in its chemical composition, but merely in its less compact state of aggregation. It is to be regretted that so much valuable matter should be wasted as is generally the case, or at best, used only for manure.

The value of silk as far as the tinctorial arts are concerned, lies in its affinity for colours and in its relations to light. In its affinity for colours it is generally pronounced to hold an intermediate place between wool and cotton. Like the former it has a strong affinity for picric acid, the aniline colours, archil, etc. Like the latter it works well with salts of iron. It is very readily injured by either strongly acid or strongly alkaline solutions. Nor is it advantageously dyed at the high temperatures suitable for wool.

The peculiar beauty of silk, and the reason why it displays most colours to greater advantage than any other material, lies in the circumstance that it reflects a larger amount of light from its surface. Hence the colours applied necessarily have a brilliance not found elsewhere.

Substitutes for Silk. From time to time rumours are circulated, that some vegetable fibre has been discovered, which is a perfect substitute for silk. This is simply an impossibility. All vegetable fibres are varieties of lignine, and are consequently in their chemical composition totally unlike silk. However glossy and lustrous they may appear, the dye-pan soon shows that in their affinity for colours, these substitutes for silk, are only equal —often indeed decidedly inferior—to cotton.

Artificial Silk. Starting from the fact that silk in the body of the insects which secrete it, exists as a fluid, gum, or varnish, capable of hardening or drying into threads on exposure to the atmosphere, attempts have been made to produce silk artificially. These attempts have been, hitherto, quite unsuccessful. Artificial silk thread has, indeed, been made to the extent of thousands of yards, but it has been weak and unable to take colours. The difficulty lies in obtaining, at a cheap rate, a nitrogeneous gummy substance, insoluble in water.

The best Italian silk contains about 1·07 per cent. of mineral matter.

Size.—The coarser kinds of glue or gelatine, are extensively used in finishing, for communicating stiffness, gloss, and an artificial body to the goods, and to some extent in dyeing. Two kinds occur in commerce, known respectively as *bone-size*, and *glue-size*.

The former is pale, clear, and forms solid, semi-transparent cakes or masses. Its adhesive power is, however, less than that of glue-size.

The latter is a dark brown, stiff, semi-fluid mass of great adhesive power. It is frequently contaminated with the exuviæ of the larvæ of carrion flies, hairs, etc.

If exposed to warmth and moisture, it is liable to mildew, as are also the goods to which it has been applied. This change can be easily and cheaply prevented.

In judging the quality of sizes, the Twaddle is utterly useless. Neither can the feel or apparent tenacity be considered as reliable.

Samples may be weighed out, and perfectly dried—a very slow process—noting the loss as water. Weighed portions may also be burnt to ashes, to find the mineral matters. These, in many cases, are considerable, including a heavy allowance of common salt. Certain additions are, of course, requisite to prevent putrefaction, but these are not always correct, either in kind or quantity. Yet, if consumers *will* always give the preference to the dealer, who asks the lowest price, or offers the highest discount and the longest credit, they must expect to buy water, salt, and the like, at a heavy price.

Soaps.—Soaps consist of any of the three alkalies, soda, potash, and ammonia, in combination with one or more of the fatty acids, especially the oleic, palmitic, margaric, and stearic. Soda soaps are hard; potash forms the so-called "sweet," or soft soaps; whilst ammonia yields a still softer semi-fluid kind, little used except in medicine, and technically called liniments. The nature of the fatty acid employed, has also a great influence on the consistence of the soap. The more stearic and margaric acids are present, the harder—other things being equal—will be the soap, while a predominance of oleic acid renders it softer.

A variety of substances in addition to alkali and fatty acids are present in soaps, to a greater or less extent. These are glycerine, derived from the oil or fat employed, water, alkaline sulphates, chlorides, and carbonates from the impurities in the potash or soda employed, rosin, silicate of soda, Cornwall clay, ground flints, potter's slip, fuller's earth, gelatine, and other kinds of nitrogenous animal matter, dissolved in soda; farina, dextrine, and a variety of other substances. On these secondary bodies a few remarks will be needed.

Glycerine is an important constituent of every kind of oil and fat, in which it exists in combination with the fatty acids above mentioned. When these, in the process of soap-making, combine with soda or potash, the glycerine is set free, and in the case of hard soaps is drawn off along with the spent lyes.

In the soft potash soaps, it remains blended with the mass. Its presence must not, on any account, be considered an adulteration or impurity, since without impairing the cleansing powers of the soap, it renders it more emollient and kindly in its action, whether upon the human skin, or upon animal or vegetable fibre.

Accordingly many soap-boilers now endeavour to re-incorporate the eliminated glycerine with their hard soaps. Water, to a certain extent, is present in soaps, hard or soft. It may, however, by dexterous management, be added even to 80 per cent., though the soap all the time appears quite firm, and in such proportions must be regarded as a fraudulent admixture. To determine the amount of water present, a known quantity, say 1000 grains, is reduced to fine shavings, dried at the heat of 212° Fahr., and the loss noted. This method, though not absolutely accurate, is sufficient for all practical purposes.

When several samples have to be compared, a good idea may be obtained by putting equal weights of each, into a number of small tin cups, pouring upon each an equal measure of boiling water, which should not be much more than will suffice to dissolve them, stirring till melted, and then setting them aside. When cold, they will be found to have formed jellies, differing greatly in consistence according to their respective amounts of water; the dry samples being firm, whilst those containing large proportions of water, will be semi-fluid.

In soft soaps the water is from 45 to 55 per cent., in hard mottled soaps about 35, in curd soaps from 20 to 30, and in fitted yellow and white soaps 40 to 60.

Sulphate and muriate of potash are invariably present in soft soap, as the caustic alkali from which it is made is never quite pure. They do not ordinarily interfere with its quality In hard soaps the sulphate and muriate of soda are less commonly found, since the impurities contained in the soda are removed in the spent lyes. Sulphate of soda is sometimes added in order to harden soft kinds of fat, and common salt is occasionally employed as an adulterant. The detection of these salts is easy. Dissolve a little of the soap in distilled water, and add pure nitric acid enough to combine with the alkali, and cause a separation of the fat, which will rise to the top. Pour off the clear liquid beneath this, and add to one portion thereof a little nitrate of baryta dissolved in pure water. If a white precipitate is formed, alkaline sulphates are present in the soap. To another portion solution of nitrate of silver is added in like manner. If a white curdy precipitate is formed, either chloride of potassium (muriate of potash) or common salt is present.

Carbonate of potash or of soda, may be found in soaps when the alkali employed has not been duly causticized. It generally

appears in hard soaps in the form of an efflorescence like hoar frost over the bars.

Rosin is a common ingredient in yellow soaps. In all soaps intended for the use of the dyer or printer, it is an objectionable impurity, imparting to the goods an unpleasant clamminess or stickiness. It may be easily detected. Dissolve some of the soap in as little boiling water as possible. Add enough hydrochloric or dilute sulphuric acid to combine with the alkali, and liberate the fatty matters. Then cover the vessel in which the whole is contained, with a lid or a plate of glass, and set it aside for a few minutes. On uncovering it, rosin, if present, may easily be detected in the cake of fatty substances by its smell and taste, and by the peculiar stickiness which it imparts to oils and fats with which it is mixed.

Silicate of soda as a constituent of soaps has given rise to a great variety of opinions. Some condemn it as a mere adulteration and even deny that it has any detergent powers. The result of my own observation is that a silicated soap, *properly made*, can be advantageously used for almost every purpose to which soap is applicable, excepting perhaps the clearing of madder-work. Very much, however, depends upon the manner in which the silicate of soda is incorporated with the soap.

Insoluble silica and alumina, in the various shapes of Cornish clay, powdered pumice, ground flints, potters' slip, and fuller's earth, can be and often are added to soaps to a considerable extent. Their action is merely mechanical, that is, they cleanse by scraping or abrading the dirt and grease off the bodies to be purified, and of course they roughen the fibre. This action will necessarily be unequal, and the goods will then take any dye unevenly, the colour being deposited most heavily where the surface has been most acted upon. We must therefore consider insoluble silica and alumina if not as direct adulterations, as additions which for manufacturing purposes cannot be recommended. Their detection is not difficult. A weighed portion of the soap is dissolved in dilute spirit of wine. The liquid is filtered, and the insoluble matter which remains on the filter is dried and weighed.

Animal matter other than fat, such as tendons, intestines, ground bones, waste glue, etc., can be regarded in no other light than a filthy adulteration. It is to be regretted than any soap-maker should derive a portion of his materials from the knacker's

yard, and that even the offal of the fish market should find its way into the soap-pan. Soaps so contaminated give a most nauseous odour to any wool, yarn, etc., that is scoured with them, and should therefore be carefully avoided. The detection of such impurities is not difficult. A little of the soap is dissolved in hot water, and decomposed by the addition of a little hydrochloric acid. The spurious animal matters will be entangled in the cake of fat which separates out, and may be easily recognized.

Farina and dextrine are less formidable. They add, of course, nothing to the value of a soap, but they have no action positively injurious. To detect them dissolve the soap in strong spirit of wine. Farina and gum remain undissolved, and may be separated from the other articles by filtering. Farina is then easily recognized by adding a drop or two of the tincture of iodine, which if farina be present will give to the mass a deep blue-black colour. Dextrine (British gum) may be dissolved out from any mineral impurities present in a little hot water, and can then be readily recognized.

The normal ingredients of soap, the fatty matter, and alkali, are determined as follows: take 100 grs. of the sample, dissolve in hot water, avoiding excess in a small and very light glass-beaker. Add hydrochloric acid in slight excess, and set the glass aside till the oils and fats congeal into a cake at top. This crust is then carefully pierced with a needle, the liquid poured off and the beaker weighed. After deducting the tare, this gives the amount of fatty matter.

Some analysts put along with the soap a weighed quantity—say 100 grs.—of pure white wax. The decomposition is managed as above, the cake of fatty matter and wax is taken out of the beaker and weighed. The weight, after deduction of 100 grs. for the wax added, shows the amount of oil or fat.

This latter process is preferable for soaps containing a large amount of oil; or of any fat that congeals only at very low temperatures.

The amount of alkali is determined as in ALKALIMETRY.

A good soap should not only be free from the impurities above mentioned, and from excess of water, but should be neutral, the alkali and fat being duly balanced. If either of them be in excess, or if they are not well imcorporated and combined, disappointment to the consumer must result.

The quality of the fats employed is also of the highest importance. For the use of the dyer and printer, the following alone should be employed, singly or in mixture:—Tallow, palm-oil, cocoa-nut oil, olive oil, rape-seed oil and its congeners, and sunflower seed oil. Of these common convention assigns the superiority to tallow. Nevertheless, I hold that well-made palm and cocoa-nut oil soaps leave the fibre in a more desirable condition than any tallow soap. The following oils and fats should be carefully avoided:—Train oil, cod fish oil, linseed oil, kitchen refuse, fat collected by bone boilers, grease separated out from accumulated soap lyes. All these give evil-smelling, clammy soaps.

Soap Powders.—(*Washing Powders, Scouring Salts, Washing Sugars, Soap Ashes, Extracts of Soap, Extracts of Fuller's Earth, Saponaceous*, etc., etc., etc., *ad infinitum.*)—These are bodies which have been very largely used, not only for domestic, but also for manufacturing purposes.

They concern the dyer and printer only in as far as they are used instead of, or along with soap, ammonia, or carbonate of soda, for cleansing wool, yarns, or pieces preparatory to being dyed or printed.

They consist, generally speaking, of common carbonate of soda crystals, reduced either by grinding or by fusion and stirring during solidification to a fine powder. This powder differs in nothing from the ordinary crystallized carbonate of soda; it contains the same amount of soda, of carbonic acid, and of water. Being, however, in a state of fine division it is much more rapidly, though not abundantly soluble in water, which for certain purposes is an undoubted advantage. To this powder a variety of ingredients are added; some to effect a real or supposed improvement in its quality, others for the less righteous purpose of disguising its appearance or reducing its cost.

Among the beneficial additions, the chief are palm oil, cocoa-nut oil, and soaps of different qualities. Among the disguises and adulterants we may reckon rosin, sulphate of soda, common salt, and in some few cases even chromate of lead in the state of paint!

The amount of available alkali in any of these bodies may be determined by an ordinary alkalimetrical operation (see ALKALIME-

TRY). To estimate approximately soap and oils, dissolve the sample in as little water as possible, when these substances will separate out. To find the amount of moisture, weigh out 100 grs., dry it carefully at a steam heat and note the loss. Rosin is a most objectionable ingredient, for reasons stated under SOAP. Sulphate of soda and salt merely diminish the cleansing power of the soap powder without imparting any property positively injurious.

The so-called "dry soaps" which have at present a very large consumption, belong also here. They consist of a soap made perfectly free from water, by means well-known to every soap-boiler, and in that state ground to powder, and mixed with caustic soda and carbonate of soda. They are powerful detergents, but obviously less safe—for manufacturing purposes at least—than common soaps. The name is evidently deceptive, since it leads consumers to think that they are buying merely soap, less the ordinary amount of water.

Soda, Acetate.—A very soluble salt formed by neutralizing acetic acid with soda. Soluble also in alcohol. Its uses are not extensive.

Soda, Aluminate.—(Known also as *Alkaline Pink Mordant.*)—This salt was formerly prepared in an impure state, by adding caustic soda in excess to a solution of common alum, or of sulphate of alumina, and boiling till the precipitate at first formed, was re-dissolved. It was, of course, contaminated with sulphate of soda, and if common alum was employed, with sulphate of potash also.

It now occurs in commerce, in the solid form, and in a state of nearly absolute purity.

This salt is used by printers, as a mordant for pinks, the cloth being passed through sal-ammoniac, chloride of zinc, etc., to fix the alumina upon the fibre.

Its use among dyers is only in its origin. I may venture to say that the aluminate of soda is capable, when properly treated, of producing every effect producible by alum, and in addition, many others peculiar to itself.

It is remarkable that, although of an alkaline nature, it is capable of depositing its base, and consequently of fixing colours, upon wool.

An aluminate of potash can be made in an analogous manner, but is more expensive, and less useful.

Soda-ash.—A powder of a white, or very pale white-grey colour. It should be entirely soluble in water; if any insoluble matter is left behind, it will be either lime, silica, or particles of carbon. It should not display a brownish or yellowish shade, neither should it change colour on exposure to the air. Either of these circumstances shows the existence of compounds of sodium and sulphur, which, in some cases, may produce injurious effects.

It should not contain hard lumps, slowly soluble. These result from negligent workmanship, and are productive of waste, as they often remain undissolved.

Soda-ash is sold at so much per cent. of actual or available alkali present in the sample. The strength of a *pure* soda-ash, would be 58½ per cent. Such an article, however, does not occur in commerce, though every alkali-manufacturer seeks to get his ash as strong as possible, and samples at 54 and 55 per cent. may easily be met with. These are the best for consumers, since weaker kinds are made by letting down the strong, either with common salt or with "weak-ash." "Weak-ash" is made from the mother-liquor remaining from the preparation of crystals of soda, evaporated down to dryness, and furnaced over again, and of course, contains all the impurities.

The subjoined table shows the amount of actual soda-ash present in solutions of different strengths.

Twa.	*Per cent.*	*Twa.*	*Per cent.*
36°	14·8	28°	11·9
35°	14·5	27°	11·5
34°	14·1	26°	11·1
33°	13·7	24°	10·4
32°	13·3	22°	9·6
30°	12·6	20°	8·9
29°	12·2		

Some kinds of soda-ash contain caustic soda to a considerable extent. To detect this, determine the total per centage of alkali in the sample. (See ALKALIMETRY.) Then take another portion, dissolve it in pure water, add to the solution chloride of barium in large excess, filter, wash slightly, and again determine the alkali in the clear liquid. This second determination shows the amount

of caustic alkali present, and if subtracted from the first, the remainder will show the per centage of real carbonate.

Soda-ash containing caustic alkali, loses strength on exposure to the air, the caustic soda taking up its due amount of carbonic acid from the air gains weight, and, of course, contains a smaller per centage of real alkali. For some purposes it is unsafe, and in any case, when caustic soda is required, it is better to buy and use it under its own name, instead of in an uncertain and variable mixture.

To detect sulphide (sulphuret) of sodium, a slip of paper steeped in the nitroprusside of sodium, is dipped in the solution of the sample. If this impurity is present, the paper will turn a violet colour.

The moisture in a sample of soda-ash may be determined, if required, by weighing out, say 200 grs., and heating it to about 400° Fahr. for an hour. It is then cooled, weighed, and the loss noted as moisture.

Soda, Bicarbonate.—(Sometimes called merely *Carbonate.*)—A white powder, containing two equivalents of carbonic acid, in union with one of soda. It is a much milder alkali than the common crystal soda, or than soda-ash, and is, therefore, useful where corrosive action is especially to be avoided. It is less soluble in water than common soda.

Bisulphite of Soda.—(*Leucogene.*)—If common soda crystals are dissolved in water, and perfectly saturated with sulphurous acid gas, they yield the above salt, which may either be kept in the liquid state or crystallized.

Bisulphite of soda is a bleaching agent, applicable both to vegetable and animal fibre, though whether, in the latter case, it offers any advantage over sulphurous acid gas, as present in the brimstone stove, either in efficiency or economy, is doubtful. It appears not only to bleach, but to mordant the goods for some colours.

Soda, Caustic.—(*Hydrate of Soda.*)—This substance differs from the carbonate of soda in containing no carbonic acid, and being consequently a much more powerful detergent, and more corrosive in its action. It is readily soluble in water, deliquescing on exposure to the air. It is sold both in the solid state, and as

ley. A saturated solution marks 100° Tw., boils at 266° Fahr., and contains nearly 37 per cent. of soda. The ley commonly sold stands about 60° Tw., containing 20 per cent.

Its uses are various. It is an essential ingredient in all hard soaps. It may be used with due care in bleaching cottons, but is very destructive to woollen and silk, and if used for scouring, the least excess in quantity, strength, or time must be carefully avoided.

Soda, Chromates of.—These salts correspond respectively to the chromate and bichromate of potash, which they precisely resemble in their behaviour and properties. As the equivalent of soda is lower than that of potash, they contain in a given weight a larger amount of chromic acid than the corresponding salts of potash. This circumstance, joined to the lower price of soda, ought to give them the preference. Unfortunately they are very easily adulterated, and such adulteration does not reveal itself by the appearance of the sample. Hence, the dyer is always at a loss without submitting every sample to a quantitative analysis. As a necessary result, the chromates of potash retain the preference.

Soda Crystals.—(*Carbonate of Soda Crystals, Scotch Soda, Newcastle Soda, Washing Soda.*)—If soda-ash is dissolved in water, and the solution concentrated, the carbonate of soda separates out in a crystalline form, containing 10 equivalents, or about 63 per cent. of water. The greater part of the impurities, such as sulphate of soda, chloride of sodium, caustic soda, silica, etc., remain in the mother liquor. The crystals are consequently purer and more uniform in composition than soda-ash, and for many purposes, therefore, preferable. If exposed to a gentle heat, the crystals melt in their own water of crystallization. In the open air they effloresce, and fall more or less completely to powder, losing an amount of water, which varies with the temperature and degree of atmospheric moisture. They dissolve in twice their weight of cold, and in less than their own weight of hot water. A solution saturated at 46° Fahr., marks 21° Tw. If honestly made, these crystals vary exceedingly little in quality, accordingly as they are more or less completely freed from the mother liquor with its impurities. A spurious article is, however, sold sometimes as washing soda, sometimes as "common soda," which needs

exposure. The materials for its preparation are salt cake, the dry sulphate of soda, a quantity of lime, and some soda-ash. The result is a mixture of sulphate and carbonate of soda in fine large crystals, which to the eye might pass for a genuine soda. It may easily be detected by an alkalimetrical process, as its saturating power will be very small in comparison with good soda crystals. If a little of the spurious kind is neutralized with muriatic acid, and tested with chloride of barium, it will also indicate a large amount of sulphuric acid.

An article has recently appeared in the market, under the name of "carbonated crystal," which the maker asserts, when dissolved in water, does not raise the Twaddle of the solution; which circumstance—strange, if true—is to be of great but unexplained advantage to the consumer.

Soda, Hyposulphite.—A compound of soda and hyposulphurous acid. It forms clear clourless crystals of a peculiar sulphurous taste, readily soluble in water.

Its uses are extensive and increasing. Under the name of "*green mordant*" it is used as a means of fixing a certain class of aniline greens upon the fibre. As "*antichlore*" it is used by bleachers to counteract the effects of any excess of chlorine which may remain in the goods from the use of bleaching-lime. It has been employed to prepare, by double decomposition, a hyposulphite of alumina, to be used as a mordant. The results have been not very satisfactory.

It has also been used in the production of bronzing or argentine effects, in conjunction with a salt of copper, which it effected by covering the fibre with a film of sulphuret of copper.

Soda, Nitrate.—(*Cubic Petre, Soda Saltpetre, Chilian Saltpetre.*)—A compound of nitric acid and soda, occurring naturally in immense deposits at Atacama in Bolivia. It forms cubic crystals, and being slightly deliquescent is always damp.

Its direct uses in the tinctorial arts are very limited, being confined to a few cases in colour-mixing, where it is added to prevent a mixture from drying.

Its indirect uses are very important. It is the source of nitric acid and is used in making the arseniate of soda.

Soda, Nitrite.—This salt has hitherto been a mere chemical

curiosity, without use in the arts. It will probably be employed to some extent by dyers and printers, along with the naphthaline colours.

It may be prepared as follows:—Put into a roomy cast-iron pot some refined nitrate of soda, with several times its weight of clean iron borings or turnings, and melt it at a red-heat, which must not approach to whiteness. When a small portion taken from the crucible with a rod and tested with sulphuric acid shows a strong outburst of nitrous fumes the mass is poured out. When quite cold it is dissolved in water. Any undecomposed nitrate is allowed to crystallize out, and removed. The residual liquor is then saturated with nitrous gas, obtained by heating starch in nitric acid, and is then preserved in stoppered bottles.

Soda, Plumbate (erroneously called *Plombate*).—This is a compound in which an oxide of lead plays the part of an acid. It is best formed by melting caustic soda in an iron crucible with the peroxide of lead, dissolving the resulting mass in condensed steam-water, and allowing the liquid to settle in a covered vessel.

Being gradually decomposed by the carbonic acid of the atmosphere, it should be carefully protected from the air, and only be made in small quantities at a time.

Very similar in its properties and nature and more frequently used is the PLUMBITE OF SODA. This is made either by boiling litharge in strong caustic soda, or by adding caustic soda to a strong solution of nitrate or acetate of lead till the precipitate first formed is redissolved.

The same precaution is needed for its preservation as for the plumbate.

A plumbate and plumbite of potash can be made in an analogous manner, employing caustic potash instead of caustic soda, but as they are more expensive and less efficient, from containing a smaller proportion of the oxide of lead they are never used.

The plumbate of soda is used in dyeing chrome yellows and oranges upon cotton. A great objection to their employment is that like all colours into which lead enters, they are permanent only in a pure atmosphere. Where sulphuretted fumes are present they are very soon turned a blackish grey or lead colour.

Soda, Stannate.—(*Preparing Salt.*)—An important mordant in which an oxide of tin plays the part of an acid. It is some-

times prepared as wanted by adding caustic soda to a highly concentrated acid solution of a persalt of tin until the precipitate first formed is redissolved. It is also prepared in the dry way in the solid state, and can be dissolved when wanted. The dry solid stannate should contain 70 per cent. of peroxide of tin and 30 per cent. of soda. To ascertain its amount, a portion of the sample should be dissolved in a small quantity of water, slightly acidulated with hydrochloric acid and some strips of clean pure metallic zinc placed in the solution. The tin will be thrown down in the spongy state. This is then carefully collected, washed, redissolved in a small quantity of hydrochloric acid, and its amount determined as directed for TIN CRYSTALS.

Some consumers dissolve a fixed quantity of the stannate in a certain measure of water, and note the degree it marks on Twaddle's hydrometer. This is no test, since an adulterated or ill-made sample will raise the specific gravity of water as well as one of the best quality.

The impurities likely to be met with are common salt, an intentional fraud, and an excess of alkali, caustic or carbonated, resulting from bad workmanship. Certain additions are also occasionally made to the stannate, not with fraudulent design, but avowedly for the purpose of improving its quality. These are the tungstate of soda, the antimoniate of soda, and the arsenite and arseniate of soda. It cannot be denied that good results have occasionally been obtained with stannates containing a certain proportion of these admixtures, but it is far from proven that they have any advantage over a well-made pure stannate.

The amount of water in a hydrated or crystallized stannate is 20 to 27 per cent.

In printing it is used to prepare calico for receiving the so-called steam colours, the cloth being afterwards passed through an acid, generally dilute sulphuric acid, which combines with the soda leaving the oxide of tin combined with the fibre.

In dyeing it is less extensively used though it is an efficacious mordant for cotton, serving amongst other purposes to fix several aniline colours upon that fibre. In using it for mordanting the cotton warps of mixed goods, one precaution is needed. The sulphur in the wool is liable to react on the tin of the stannate, and turn the fibre brown or blackish, a change which does not occur when the tin is present in an acid, instead of an alkaline compound. To prevent this reaction, the solution of stannate

must be at a low temperature, not too concentrated and must not be allowed to act too long.

The stannate of potash, an analogous compound, has fallen into disuse.

The *stannites* of soda and potash are salts in which the tin, though playing the part of an acid, is present, not as peroxide, but as protoxide. They are very rarely used.

Solution of Tin.—This mordant, often called simply "solution," consists of tin dissolved in a mixture of nitric and muriatic acids. The proportions used differ greatly both as regards the weight of metal and the relative amount of the two acids. The result is generally perchloride of tin, with an admixture of protochloride, and with a residue of nitric acid. Some makers add also sulphuric acid, by which the result is greatly complicated. The finished spirit generally marks 44° Tw., or thereabouts, and is a clear pale yellow liquid.

It is very much used in cotton dyeing, especially for the warps of mixed piece goods, where it serves along with sumac or myrobalans as a mordant for clarets, browns, etc.

Sooranjee.—A plant growing in India, known to botanists under the name *Morinda citrifolia*. In its native country it has long been employed as a dye-ware, yielding colours analogous to those obtained from madder. The part employed is the root which is imported in pieces from one to four inches in length, and which vary in diameter from one-half to one-eighth of an inch. The bark of the thick pieces is thin, whilst that of the thinner portions is much thicker. Outwardly the colour of the root is a light brownish grey. If cut across the bark displays a fine yellow or brownish section, and the wood a pale yellow.

This root contains a colouring matter, morindin, which is obtained in a state of purity by extracting the bark of the root with boiling alcohol. Morindin forms yellow lustrous crystals, sparingly soluble in cold, but readily in boiling water, from which on cooling it is deposited as a jelly-like paste. In alkaline solutions it dissolves with an orange-red colour. In oil of vitriol it gives a purple colour, and after standing for some time and dilution with water, it is thrown down in yellowish flocks, but in a modified state, as it is now totally insoluble in water, and forms with ammonia a solution which is not orange but violet.

Solutions of morindin give the following lakes:—With sub-acetate of lead, crimson, very unstable; with alum and ammonia, red. Perchloride of iron darkens the colour, but yields no precipitate.

Morindin attaches itself to cotton prepared for Turkey-red dyeing, and yields shades which are fast, but less beautiful than those produced by madder.

It has also an affinity for ordinary mordants, dyeing red with alumina, and purple to black with the acetate of iron. It attaches itself to mordants also after being treated with sulphuric acid.

Sorghum red.—A colour obtainable from the Chinese sugar cane, *Sorghum saccharatum*. The canes after extraction of the sugar, are allowed to ferment for two weeks with precautions to prevent putrefaction. They are then dried, ground, thoroughly extracted with cold water, drained, and again extracted with weak soda lye. The alkaline extract contains the colour which is deposited in red flakes on cautiously neutralizing the liquor with sulphuric acid. The colour thus precipitated is collected, washed and dried. It is soluble both in alkalies and dilute acids, and can be used for dyeing wool and silk with the ordinary tin mordants. The shades produced resist light and hot soap lyes.

The colour is not in the market, and it is very doubtful whether the yield is sufficient to pay for the tedious process of extraction.

Crimson Spirits.—A name given in some districts to RED COTTON SPIRITS.

Plum Spirits.—A solution of tin in an aqua-regia containing but a small relative proportion of nitric acid. It is generally a mixture of proto and persalt of tin, and is used by dyers along with logwood and peach wood for reddish purples.

Purple Spirit.—A preparation of tin, differing from "scarlet spirit" chiefly in containing a much larger relative amount of metal. It is, like scarlet spirit, mainly a sesquisalt of tin, and is still more readily decomposed by exposure to direct sunlight, or to an elevated temperature. It should therefore only be prepared immediately before it is wanted.

It is used in producing certain shades of purple upon woollen goods.

Red Cotton Spirits.—A solution of tin in a mixture of nitric and muriatic acids. It differs in no essential point from the so-called SOLUTION OF TIN, but is generally sent out at a lower specific gravity. The proportions of metal and acids vary greatly in the hands of different makers, each maintaining the superior excellence of his own formula. The quality and practical value of those preparations cannot be determined by the most exact chemical analysis since the manner in which the ingredients are put together is of even more importance than their amount. Too high or too low a temperature in the prepartion of the spirit may seriously modify the result, or even render it altogether worthless.

Royal Blue Finishing Spirit.—A preparation of tin used, as its name implies, in finishing royal blues upon woollen and worsted goods. It is a protosalt of tin, in combination with the muriatic, sulphuric, and occasionally oxalic acids in very various proportions. The only test for its quality is actual use.

Royal Blue Spirits.—A mixture of the sulphuric, nitric, and hydrochloric acids, in varying proportions according to the views of the compounder or user.

It is a deep orange-coloured liquid, giving off pungent irritating vapours. Its strength varies from 70° to 90° Twaddle.

Its principal use is for dyeing royal blues upon wool, and woollen, and worsted goods, where it serves to decompose the prussiate.

Its quality can only be ascertained by actual use.

Where red prussiate of potash is used for royal blue dyeing, the presence of nitric acid in the royal blue spirits is quite unnecessary, if not injurious.

Yellow Spirits.—This name is given to various preparations of tin, used for dyeing yellows upon wool and worsted with quercitron bark, fustic, etc. The acids present are sulphuric and muriatic, but the respective proportions of these, as well as the amount of tin, and the strength of the article as sent out, vary greatly. To award an absolute superiority to any one of these mixtures is

impossible on account of the different materials required to suit the methods followed by different dyers. As a general rule we may say that where a yellow is required which shall exhibit a greenish shade "overhand," that is when held up to the light and viewed horizontally, or along its surface, an excess of free acid must be carefully avoided.

Starches.—(*Fecula, Farina, etc.*)—Starch exists in a great variety of vegetables, but is only extracted from the seeds of the cereals and from certain roots. In its chemical nature it stands in very close relation with the gums and the sugars, into either of which it can be artificially—as well as naturally—converted. Starches are insoluble in cold water and form a jelly on boiling. They are coloured a blackish-blue by a solution of iodine and a yellow by bromine. All are perfectly insoluble in alcohol and ether, and are incapable of reducing the salts of copper and silver. From whatever plant they are obtained, they are identical in constitution, consisting of carbon, oxygen and hydrogen, in the same proportions. Nevertheless they exhibit characteristic differences, not merely in their appearance under the microscope, but in their chemical behaviour. Thus some kinds when dry, absorb moisture much more rapidly than others. The tenacity of the jelly, which starches form with an equal quantity of water, varies extremely. To determine the hygroscopic character of a starch weigh out 200 grs., and place them in the desiccating apparatus over sulphuric acid. After some hours, note the amount of moisture lost. Now expose the dried sample to the atmosphere, and by weighing from time to time, observe at what rate the lost moisture is recovered. Starches that readily absord moisture are of relatively low value for finishing and stiffening purposes.

To determine, comparatively, the relative tenacity of various starches, weigh out 24 grs. of each sample, and mix each with 400 grain measures of pure water in capsules of a proper size. The mixtures are then heated and boiled briskly for three minutes, constantly stirring, and are then poured each into one of Clarke's conical test glasses, which the mixture nearly fills. Note the exact time when each glass was filled, and allow each to stand for precisely two hours, in a current of air. Some flat round pieces of sheet brass should have been previously provided, each seven-tenths of an inch in diameter and alike in weight, not exceeding

50 grs. One of these is laid upon the surface of the jelly in each glass, and weights are added till the surface is broken, and the disc begins to sink in. The weights required may vary from 87 to 2446 grs. The more tenacious the starch the greater—other things being equal—is its value for thickening colours and for finishing purposes.

Starch is sometimes deteriorated by the presence of nitrogenous matter. To detect this, dissolve one part of mercury in two parts of nitric acid of 50° Tw. at a gentle heat. When dissolved boil the liquid for a few minutes.

If the sample is coloured reddish by this liquid, nitrogenous matter is present.

The presence of dirt of various kinds may be observed either on mixing the sample with water, or on allowing the solution to cool in tall glasses.

Mineral matters are sometimes extensively present, such as Cornish clay, heavy spar, gypsum, etc. To detect these, a weighed portion is burned to ashes in a platinum crucible, when these impurities will remain, and may be weighed. A genuine starch leaves a very small trace of mineral matter.

Starch made from wheat flour is generally preferred to all others—a fact which gives rise to several grave problems, chemical and sociological. We ask firstly, for a process of making starch wherein the nitrogenous matters, in which the main value and nutritive powers of wheat lie, shall not be wasted or deteriorated, but brought out in a state fit for human food.

Secondly, can a starch equal to that derived from wheat be prepared from some substance of less value or valueless as human food? Can *e.g.* lignine be converted into starch, or can matters capable of replacing starch and dextrine in thickening colours, stiffening woven materials, etc., be obtained from mineral sources?

Lastly, we may even ask whether it is consistent with good policy to allow wheat flour to be used for such purposes? Whether it would not be prudent to prohibit any alimentary substance, containing above a certain per centage of nitrogen, from being used for any purpose soever, for which such nitrogen is not essential.

Sugar.—A substance or rather class of substances nearly related to the gums and starches. Three of the sugars only are

likely to have any bearing upon our subject, viz., cane-sugar or sucrose, fruit-sugar or fructose, and starch-sugar or glucose. Fructose is in its composition and properties intermediate between the other two, whilst glucose is the final result of the action of heat and acids, etc., either upon the starches or the other sugars. The sugars, especially glucose, are powerful reducing agents, and have further the property of suspending the ordinary relations of metallic compounds.

If sugar be added to a metallic solution, it will be difficult—in some cases impossible—to detect and estimate the metals present until the sugar has been destroyed.

On this account it interferes seriously with the action of mordants, and if present, as may sometimes happen in the artificial gums, or if unwittingly produced in colours by the action of heat and acids upon the starch, it may interfere seriously with the results.

Sulphate of Soda.—(Glauber's Salts, called also vulgarly Sally Nixon, in corruption of its ancient name, *sal enixum.*)

This salt is made by dissolving the salt cake from the manufacture of nitric and hydrochloric acids, and allowing the solution to crystallize, having previously neutralized any excess of acid, and allowed any insoluble matter to subside.

Sulphate of soda crystals should be neutral in their composition, and should have a very feeble alkaline reaction. They should dissolve in water without leaving any residue, and above all, they should be free from compounds of iron. If they exhibit a rusty colour, or if when dissolved they deposit a brownish sediment on the addition of carbonate of soda, iron is present.

Sulphate of soda is very extensively used by dyers for levelling, that is for preventing the colours from attaching themselves to the fibre in an irregular manner.

By calico-printers it is used to fasten the lead mordants employed in dyeing chrome-yellows and oranges.

The crystals of sulphate of soda lose their water of crystallization in a dry warm air, and become covered more or less deeply with a white powder—the anhydrous salt. This change does not in the least impair their usefulness. For solution, one part of the crystallized salt requires at 68° Fahr. 1¾ parts of water, the resulting liquid marking 25° Tw.

This salt has certain indirect uses which concern the dyer.

Thus it is by some manufacturers added both to various mordants and to the WASHING or SCOURING POWDERS, often used for cleansing wool previous to dyeing.

Sulphuric Acid, commonly known as *Oil of Vitriol*, or by abreviation simply "Oil."—The commonest and most important acid, which is to the chemist and the dyer what iron is to the mechanic. It occurs in commerce in four different states, and in various degrees of purity.

The strongest kind, fuming, or Nordhausen acid—so called from a place where it was long manufactured—was formerly prepared by distilling dried copperas at a high temperature. It is now obtained in greater purity from the alkaline bisulphates.

It is generally of a pale brown colour, viscid like oil, and has the specific gravity 1·896°, or 179½° Twaddle. It consists of two equivalents, or 80 parts by weight of the dry, solid acid—a compound not known in commerce—combined with 9 parts of water. It gives off copious fumes, and if boiled, exposed to damp air, or mixed with a little water, is converted into common oil of vitriol. Its price is necessarily high, and its uses, at present, very limited, being mostly confined to the preparation of extract of indigo, and even there the advantage said to be derived from its employment, is far from being indisputable.

Double or rectified oil of vitriol is prepared in chambers of lead, by a very familiar process, which need not be here described. It is then concentrated in glass or platinum retorts.

DOUBLE OIL OF VITRIOL consists theoretically, of one equivalent, or 40 parts of the dry acid, combined with one equivalent, or 9 parts of water.

It has, in its highest state of concentration, the specific gravity 1·849°, or 170° Twaddle. It is a clear, colourless, oily fluid, weighing 18½ lbs. to the gallon. It boils at 620° Fahr.

It has the power of expelling all other acids from their combinations in the moist way. If mixed with water, a great elevation of temperature takes place, which if one part of water is added to four of oil of vitriol, reaches 300° Fahr.

It rapidly destroys most organic bodies, depriving them of their oxygen and hydrogen, and leaving the carbon behind as a blackish mass. Upon certain colouring matters, however, such as indigo-blue and alizarine, the red colour of madder, it does not possess this destructive action. If any particles of organic

matter, such as saw-dust, or straw, fall into a carboy of oil of vitriol, they are decomposed, and impart a dark colour to the liquid. Oil of vitriol takes up water from the air, if left in unstoppered bottles, and thus dilutes itself and loses strength.

SINGLE OIL OF VITRIOL is an acid slightly weaker than the "double." It generally marks 165° to 167° Twaddle, possesses otherwise the same properties as the double kind, and can be applied to the same purposes, save dissolving indigo, for which it is totally unfit.

BROWN OIL OF VITRIOL, or chamber acid, is the sulphuric acid as it is run from the lead chambers, without having been submitted to any subsequent concentration or purification. Its specific gravity is not higher than 1·75° or 150° Tw., and is sometimes lower. It has a brown colour, from traces of organic matter, and is more liable to contain traces of nitrogen compounds. In strength it is about 16 per cent. below double oil of vitriol. In cold weather, it is liable to freeze or solidify, an occurrence which frequently leads to the breakage of the carboys, and the loss of their contents. It may be applied to the same purposes as the two former kinds, but must not be allowed to come in contact with indigo.

The impurities and adulterations in sulphuric acid, are various. Sulphate of lead is often present. This body is soluble in concentrated oil of vitriol, raising the specific gravity, without, of course, adding anything to the strength. It is detected by diluting a portion with pure water, when the sulphate of lead, not being soluble in dilute acid, settles to the bottom as a white sediment. It is rarely large in quantity, and is never, I believe, added purposely.

Sulphate of soda, in the dry state (saltcake), is frequently added, in order to raise the specific gravity of diluted acids. It may be detected by evaporating away a portion at a red heat when any alkaline salts present will remain behind.

Nitric oxide is frequently present, and is, under many circumstances, destructive to colouring matters. To detect it, put a little of the suspected acid in a test tube, or, in default, in a wine glass, and drop in a clean fragment of the sulphate of iron (copperas). If the least trace of nitric oxide, or hyponitrous acid be present, a faint reddish tinge will appear in the liquid, and gradually deepen.

Arsenious acid is frequently found in samples of sulphuric

acid, made from iron and copper pyrites. In many cases this substance, being capable of acting as a reducing agent, may produce injury. Acid prepared from Sicilian sulphur, should, therefore, be used in dye, print, and colour works, to the exclusion of that obtained from pyrites.

The following table shows the amount of real acid contained in the liquid acid at different strengths :—

Twaddle.	*Dry Acid per cent.*	*Oil of Vitriol per cent.*
169½	81·54	100
169	79·90	98
168	78·28	96
166	76·65	94
164	75·05	92
162	73·39	90
159	71·75	88
155	70·12	86
151	68·49	84
147	66·86	82
142	65·23	80
137	63·60	78
132	61·97	76
128	60·34	74
124	58·71	72
119	57·08	70
115	55·45	68
110	53·82	66
105	52·18	64
101	50·55	62
97	48·92	60
93	47·29	58
89	45·66	56
85	44·03	54
81	42·40	52
77	40·77	50
73	39·14	48
70	37·51	46
66	35·88	44
63	34·25	42

Twaddle.	*Dry Acid per cent.*	*Oil of Vitriol per cent.*
59½	32·61	40
56	30·98	38
53	29·35	36
49½	27·72	34
46	26·09	32
43	24·46	30
40	22·83	28
37	21·20	26
34	19·57	24
31	17·94	22
28	16·31	20
25	14·68	18
21½	13·05	16
19	11·41	14
16	9·78	12
13	8·15	10

Sulphurous Acid.—A gaseous body well known as the fume given off during the combustion of brimstone. It is colourless, of a suffocating odour, dissolves to a considerable extent in water, and forms, with the alkalies and metallic oxides, two series of salts —the sulphites and the bisulphites. The latter contain twice as much sulphurous acid as the former, or two equivalents of acid to one of base.

Sulphurous acid, if exposed to air and moisture, especially if in contact with organic or porous matter, gradually takes up an additional equivalent of water, and is converted into sulphuric acid.

Sulphurous acid is the agent in the bleaching effect of burning sulphur, as witnessed in stoving woollens. The colours thus bleached are not entirely destroyed, as in bleaching with the chloride of lime, but merely masked, and can be made to reappear by means of alkalies, sulphuric acid, etc. (See AIR.)

Sumac.—(sometimes also called *Sumach and Shumac.*)—This ware consists of the leaves, leaf-stalks, and small twigs of *Rhus cotinus*, a shrub growing in Sicily, Italy, Spain, Portugal, and

some districts of France. It is sometimes sold whole, sometimes coarsely bruised, but, most commonly, ground to a fine powder—a preparation which enables it to be somewhat more readily extracted by cold water; but at the same time disguises the presence of impurities.

The sumac of Alcamo, in Sicily, is generally preferred to all others. Its powder is green and bright, giving off a pleasant tea-like odour. The second quality, from the same district, is of a more reddish-yellow hue. Sicilian sumac is generally packed in bags weighing 1½ or 1¾ cwt. Of Spanish sumacs, that of Priego, near Malaga, is the best; then those of Molina and Valladolid. They have more of a fawn colour than the Sicilian growth.

The quality of sumac may be known to a considerable extent by its appearance. It should be quite dry, and not contain any cakes or lumps. These, if present, show that the sample has at some time been exposed to moisture, and in consequence more or less of the tannin, its valuable principle, has been converted into gallic acid, which is to the dyer and printer useless, if not actually injurious. The colour should be bright. If dull, it is probable that the sample has been mixed with sumacs of an inferior quality, or with such as have become deteriorated by long keeping. The foot-stalks and midribs of the sumac leaf can always easily be distinguished under the lens or microscope.

An impurity in ground sumacs, due to negligence rather than fraudulent intention, is earth or sand. This is sometimes present to such an extent, that a portion of the sumac, burnt to ashes, yields 10 per cent. of ash, or mineral matter.

In comparing different samples of sumac, they should always be laid upon papers of the same colour. Dealers generally exhibit sumacs upon pink or rose-coloured paper, which by contrast makes its green shade appear brighter and more decided.

For more exact methods of determining the value of sumacs, see DIVI-DIVI.

The uses of sumac, like those of other astringent vegetables, are either to serve as a mordant for other colouring matters upon cotton, or to dye blacks and other sad colours along with preparations of iron. For the former purpose, the Sicilian sumac deserves the preference, especially in the production of peach wood reds upon cotton.

In strength, sumacs are found in practice to vary to an extent far greater than the published analysis would seem to indicate

Twenty pounds of some kinds will be found more serviceable than fifty of others. The determinations, published under the name of Sir H. Davy, are not reliable. Like all other astringent matters, decoctions or infusions of sumac on long standing, or exposure to heat, are apt to turn sour, the tannin being converted into gallic acid, and becoming useless. This change is indicated by the smell and taste of the liquid, and by a ropiness which appears on the surface.

Superargol.—One of the many modifications of argol which have sprung up since its price was enhanced in consequence of the grape-disease.

Superargol is simply argol to which a certain quantity of sulphuric acid has been added, which, seizing upon the whole or a part of the potash, sets more or less of the tartaric acid at liberty.

Its uses may be gathered from its nature; but it is now very rarely met with.

Syrian Rue.—A plant known to botanists as *Peganon harmala*, a plant growing abundantly in Southern Russia, Asia Minor, Syria, etc. Its seeds yield a peculiar principle, named *harmaline*, which may be used as a yellow dye, and when oxidized yields a red colouring matter.

The name, though legitimately and appropriately pre-engaged, was nevertheless given to a certain preparation of aniline, which has now fallen into disuse.

Tannin.—Tannin or tannic acid, the active constituent of gall-nuts, sumac, and the other astringents, is when pure, a colourless, inodorous body, soluble in water, alcohol, and in ether, which dissolves one-tenth part of its weight. It possesses in a high degree that peculiar taste known as "astringent," but is quite free from bitterness. Tannin is found in a great variety of vegetable matters, very few woods and barks being entirely free from it.

Tannin is generally accompanied by gallic acid, a substance which was formerly thought took part in the effects of tannin, but which has been latterly found to be utterly useless, not merely in dyeing and printing, but also in tanning.

Tannin when in a state of solution, especially at elevated temperatures, has a great tendency to pass into gallic acid. This change occurs more readily in the crude decoctions of astringent

vegetables, than in solutions of pure tannin. It may be retarded by excluding the air as far as possible, by keeping the liquids at a low temperature, and may be altogether prevented by the addition of such substances as are opposed to fermentation. By their aid, decoctions of galls, sumac, etc., may be kept till exhausted, even in the warmest climates, without spoiling.

It is highly probable that there are several distinct varieties of tannin, or more correctly speaking, that the name tannin is applied to several bodies not absolutely identical. Thus the tannin of galls, of sumac, and logwood, forms a blue-black precipitate with salts of the peroxide of iron, whilst that present in catechu, kino, in horse-chestnut bark, and in tea, gives a green precipitate with the same reagent.

Tannin has a powerful affinity for vegetable fibre, *e.g.*, cotton. It also combines readily with the salts of alumina, tin, and iron, etc., as well as with most colouring matters. On this depends the use of tannin in dyeing cotton; the goods being steeped in an infusion of sumac, galls, or other astringent, take up or combine with a portion of tannin, and are thus enabled to combine more readily and intimately both with the mordants and the colours.

A partially purified variety of tannin is now an article of commerce. It is extracted from gall nuts, and is of a yellowish colour. It is used to a considerable extent by the calico-printers, who employ it in the fixation of aniline colours.

Artificial Tannin.—When nitric acid is allowed to act upon charcoal or upon bodies rich in carbon, a substance is formed capable of giving a precipitate with gelatine. The yield has hitherto been too insignificant to be of any practical value. It is, however, a subject worthy the attention of experimentalists, as the consumption of tannin in dyeing, tanning, etc., appears to outgrow the supply of suitable materials.

For the determination of tannin in its sources, see DIVI-DIVI.

Tartar, known also as *Bitartrate of Potash* and *Cream of Tartar.*—Argol still further purified is sold as grey tartar, and when freed as far as possible from all foreign matter, it becomes white tartar.

Of course in these preparations dregs of wine cannot be present, but the risk of adulteration with alum, salt, sulphate of soda, etc., is greater. For the detection of such impurities, see ARGOL.

In woollen dyeing the use of tartar is more limited than that

of argol, being chiefly restricted to a few of the more delicate cochineal shades, such as pinks. In printing, its uses are more extensive.

Tartar Cake.—A mixture of sulphate of soda to which some free sulphuric acid is added, and a small quantity—sufficient as the saying runs, to swear to—either of white argol, of tartar, or of tartaric acid. The whole is melted and when cold broken up. It forms flat cake-like fragments which have an intensely acid taste and corrosive action, and which attract moisture if not kept in a very dry place. It is used chiefly in stuff-dyeing for so-called sour browns.

Tartar, Liquid, called also *Protartar Spirits,* is a mixture of the tartaric and sulphuric acids, diluted with water and weighted more or less with alkaline salts. It is generally made up to about 18° Twaddle, and is a clear liquid, colourless, or slightly tinted, and having an intensely sour taste.

It is used by some dyers for "levelling" a variety of colours, amongst others aniline blues upon wool and worsted.

Tartar, Essence of.—A name sometimes given to a solution of tartaric acid in water.

Tartaric Acid.—A vegetable acid, which both in the free state and in its combination with potash, is largely used in dyeing and calico-printing.

It exists in the juice of grapes—at present the only commercial source—and in certain tropical fruits which might be rendered available for its extraction. In a pure state tartaric acid forms large colourless crystals which dissolve readily in water, and possess a very sour but not disagreeable taste.

It is frequently sold in a fine white powder, a practice which should be strongly discountenanced as tending to conceal impurities.

The chief adulteration met with is the bisulphate of potash. This fraud is very easily detected. A small portion is very strongly heated upon a slip of platinum foil. If genuine, nothing will remain, but if bisulphate of potash is present, a white saline matter remains.

Or the suspected sample is dissolved in pure water, acidulated

with some pure nitric acid, and a few drops of the nitrate of baryta are added. A white turbidity, insoluble in a large excess of pure water, shows the presence of bisulphate of potash.

Tartaric acid is occasionally used as an adjunct in dyeing cochineal colours. In printing it serves for a discharge on Turkey reds and dipped blues, and in steam blues and greens where it serves to decompose the prussiate of potash.

Thermometer Scales.—*Rule for converting Centigrade into Fahrenheit.*—If the temperature be above the freezing-point of water (0° Cent.), multiply by 9, divide by 5, and add 32 to the quotient.

If it be below 0° Cent., but above —18° Cent., multiply by 9, divide by 5, and subtract the result from 32.

If below —18° Cent., multiply by 9, divide by 5, and subtract 32 from the result.

To convert Fahrenheit into Centigrade.—If above 32° Fahr., subtract 32, multiply by 5, and divide by 9.

If below 32° Fahr., but above 0° Fahr., multiply by 5, and divide by 9.

If below 0° Fahr., add the temperature to 32, multiply by 5, and divide by 9.

The conversion of Reaumur into Fahrenheit, and *vice versâ*, is performed on the same principle, the number 4 being used instead of 5 as multiplier or divisor.

Tin.—A metal of the greatest importance to the dyer and colour-maker, from the readiness with which its salts attach themselves both to the fibre and to colouring matters, and the beauty and permanence of the latter compounds.

It is one of the less plentiful metals. The commercial supply is derived from Cornwall and from the island of Banca, and some adjacent districts of the Malay archipelago. It is, however, a certainty that tin ores abound in Australia, California, and New Grenada; and we may therefore hope that the present exorbitant prices will not be enduring.

Tin is one of the lighter and more easily fusible metals. It decomposes water in contact with acids, but is much less rapidly soluble either in dilute sulphuric or muriatic acid than zinc or iron. By pure nitric acid it is not dissolved, but converted into an insoluble oxide. By organic acids it is very slightly affected.

Hence it is preferred for pans for dyeing delicate shades, for extracting colours, etc. From its softness and great fusibility, however, it is rarely exposed to the naked fire, but is heated by steam or water, or else pans of iron and copper are fitted with a tin lining. It dissolves more readily in acids if placed in contact with copper, silver, platinum, and especially gold. Boiling muriatic acid has no action at all upon copper, if metallic tin be present in the liquid. Hence muriate of tin can be safely prepared in copper pans, if the tin be kept in excess. Zinc throws down tin readily from its solution. Lead precipitates tin slightly, the action soon coming to a close. Iron and tin placed together in an acid dissolve simultaneously, yet, by a peculiar arrangement, the former can be made to precipitate the latter. Tin forms with oxygen three compounds capable of combining with acids. The protoxide consists of one equivalent of tin combined with one equivalent of oxygen. Its salts are colourless, and have a strong affinity for an additional quantity of oxygen, whence they are capable of acting as reducing agents. The protoxide of tin, in contact with powerful alkalies, is capable of playing the part of an acid forming compounds known as stannites. The sesquioxide of tin consists of two equivalents of tin combined with three of oxygen. Its compounds are of a reddish amber colour. The so-called "scarlet spirit" consists principally of sesquioxide of tin. The peroxide or binoxide of tin contains two equivalents of oxygen to one of tin. Its salts have an oxidizing effect. The peroxide also can act as an acid, combining with alkalies to form salts called stannates. All these compounds are capable of employment as mordants, serving different purposes, according to their stage of oxidation, and to the kind and amount of acid with which they are combined. This last has so marked a modifying effect, that we can scarcely help concluding that what enters into combination with the fibre and the colouring matter is not an oxide, but an insoluble subsalt, holding a part of the acid in combination. As a rule, the protosalts of tin are preferred for wool and the persalts for cotton, the sesquisalts being in certain cases applicable to both. The compounds, where tin acts as an acid, such as the stannate of soda, are almost exclusively applicable to cotton.

Many of the ordinary dyers' spirits, those at least which are formed by acting upon the metal with a mixture of nitric and muriatic acids, contain variable relative proportions of protoxide and peroxide, according to the temperature at which the tin was

dissolved. The very same ingredients may yield a perfect persalt, or a mixture containing chiefly protosalt, according to the speed with which the metal was added to the acid. The condition of a sample of "solution," "red cotton spirit," etc., in this respect is very easily detected. The persalts of tin, as commonly prepared, have a very pale straw colour, whilst the protosalts are perfectly colourless. If a little chloride of mercury (corrosive sublimate), dissolved in water or alcohol, be added to a tin spirit, if any of the tin is present in the state of a protosalt, a white precipitate will be formed, which speedily blackens. If the tin be entirely a persalt, there will be no apparent action.

If, again, the temperature be allowed to rise higher than is required for the formation of a perfect persalt, mischief ensues. The tin may entirely or in part, be thrown down to the bottom of the vessel, in the state of insoluble peroxide, utterly useless as a mordant. This result is technically known as "firing," and is not uncommon in careless hands.

But an excess of heat, insufficient to produce firing, will destroy the affinity of the tin for the fibre. A mordant thus spoiled, cannot be distinguished by specific gravity, smell, taste, or colour, from one in a proper condition. Nor is any difference discovered, on submitting the two to ultimate quantitative analysis. Yet there are chemical means, founded upon the comparative action of light upon these fluids, by which their condition may be ascertained, as decidedly as by dyeing comparative swatches with the two kinds. In this latter case, the overheated sample will not attach itself to the fibre to any available extent, whilst the other will produce a full colour.

Such facts prove that the peroxide of tin may exist in at least three distinct states, one only of which has an affinity for animal and vegetable fibre. With the protosalts, such a distinction does not exist.

The impurities found in commercial tin, are arsenic, antimony, bismuth, zinc, lead, copper, and iron. These impurities are more dangerous in some cases than others. In scarlet spirits, they are extremely objectionable, as also in spirits for fastening any light and bright colours. Indeed, to use inferior qualities of tin in dyeing and printing, is a grave mistake, which has often led to costly failures.

The above impurities may be thus detected:—*Copper* will remain as a black powder, after dissolving the tin in muriatic

acid. It may be washed, dissolved in nitric acid, freed from excess of acid by evaporation, and mixed with excess of ammonia, which will turn it a violet blue.

Arsenic and antimony. The suspected metal is placed in a Marsh apparatus, and dissolved in *pure* hydrochloric acid. The issuing gas is burnt at the jet, and pieces of white porcelain are held in the flame. If shining metallic spots are formed on the porcelain, arsenic, or antimony, or both are present.

For the remaining impurities, a portion of the clear solution in hydrochloric acid is saturated with sulphuretted hydrogen gas. The precipitate formed may contain, besides the tin, lead, copper, arsenic, and antimony. It is digested in hydrosulphate of ammonia, with excess of sulphur for some time. If any not-volatile matter remains undissolved, it is probably sulphuret of lead.

Zinc and iron, if present, will be found in the liquid filtered off from the precipitate given by sulphuretted hydrogen. The liquid is evaporated down to a small bulk, heated with nitric acid, and then mixed with ammonia. Iron, if present, is thrown down as red-brown hydrated peroxide. It is filtered off, and the residue, after being again concentrated, is tested with *perfectly pure* carbonate of soda. A white precipitate indicates zinc. If the respective quantities of these impurities are required, the case should be placed in the hands of a professed analyst.

Tin, Acetate.—The protoxide of tin, in a hydrated state, is sometimes dissolved in acetic acid, and employed under the above name in printing. Its uses are very limited.

Tin, Bichloride of.—(Sometimes called, especially by German authorities, *Colour-makers' Composition.*)—When free from water, or anhydrous, it is a thin colourless liquid, which fumes on exposure to the air, and boils at 248° Fahr.

In the hydrous state, it exists in combination with water, and generally with more or less free acid. In this state it is the main ingredient of all those kinds of dyers' spirits which are made with a mixture of nitric and muriatic acids. There are very many ways of bringing tin into this state, according to the purpose intended. From single and double muriate, and tin crystals, the bichloride differs, by containing an additional atom of chlorine combined with the tin.

The anhydrous bichloride of tin, is used for preparing that kind of magenta known as fuschine, the muriate of rosaniline.

Tin, Crystals of.—(*Salts of Tin*).—When metallic tin is dissolved in hydrochloric acid to saturation, the liquid, on concentration deposits the protochloride of tin in combination with an equivalent of water in the form of white silky crystals.

These crystals should be dry, smooth to the touch and perfectly colourless. If dissolved in distilled water with the addition of a few drops of pure hydrochloric acid no turbidity should appear on dropping in a solution of the chloride of barium. If a white cloud appear in the liquid *sulphate of zinc*, or *sulphate of magnesia*, may be suspected as an adulterant. If *chloride of zinc* is present, the sample will grow damp on exposure to the air much more rapidly than is the case with the genuine tin crystals. To detect this impurity sulphuretted hydrogen may be passed into a solution of the crystals in water to which a little hydrochloric acid has been added. The sulphuret of tin thus formed is filtered off, and the clear liquor is evaporated down to dryness. If the sample be genuine nothing will remain after exposing the residue, if any, to heat.

It is often desirable to know the exact amount of tin present in any salt or liquid containing that metal. This may for practical purposes most readily be done on the volumetric principle.

Prepare a solution of tin of known strength by dissolving 500 grs. of the purest tin in pure hydrochloric acid so that the liquid obtained may measure exactly 20 ozs.

Prepare also a solution of iodine as follows. Weigh out 127 grs. of pure iodine, and 180 grs. of pure iodide of potassium. Dissolve them in 10,000 grain measures of water without the aid of heat. Preserve the liquid in 6 oz. stoppered bottles.

Now find the value of the iodine solution as follows. Measure off exactly such a portion of the standard tin liquid as may contain 2 or 4 grs. of metallic tin, put it in a beaker, add an excess of bicarbonate of soda, together with double tartrate of potash and soda enough to keep the liquor clear. Add a little thin starch paste, and drop in the iodine liquor from a pourette till a faint blue tint appears permanently in the glass. The number of degrees of the pourette consumed show what quantity of the iodine liquor represents 1 gr. of metallic tin.

A portion of the tin crystals, say 5 grs., is next weighed out

and dissolved in water with the addition of a very little hydrochloric acid, bicarbonate of soda and double tartrate of potash and soda as above. The starch paste is next added and the iodine solution dropped in as above till a blue tint appears. The quantity of metallic tin thus contained in the crystals is easily calculated.

Tin crystals should dissolve in a small quantity of pure water, —say 10 times their weight—without turbidity. In an excess of water they turn opaque and milky, though the liquid readily becomes clear again on adding a few drops of hydrochloric acid. They dissolve very readily in hydrochloric acid generating a considerable degree of cold.

Tin crystals should be kept as far as possible from contact with the air since they absorb moisture and are gradually decomposed with formation of the insoluble oxychloride of tin.

They are largely employed for a great variety of purposes both in dyeing and printing.

Tin, Oxymuriate.—This name is applied to a more or less perfect bichloride of tin in solution. For the use of printers it is generally prepared by the action of nitric acid upon tin crystals with due precautions. (See TIN, BICHLORIDE.)

The names *nitro-muriate, perchloride* and *permuriate,* are sometimes given to similar preparations.

Toluidine.—A base present in coal-tar. When pure it forms colourless crystalline plates. It boils at 388° Fahr., but like aniline evaporates slowly at common temperatures. By solution of bleaching lime it is coloured a brownish red, differing in this respect from aniline. If the two are present together, the brown tint alone appears, but if a little ether be added, the brown colour will be retained by that solvent and the blue colour will be found in the water.

Toluidine dissolves in alcohol, ether, the oils, and wood-naphtha. In combination with the acids it forms a series of well-defined crystalline salts.

Toluidine is accompanied by an isomeric body to which the name *pseudo-toluidine* has been given. It has not been thoroughly studied but it yields different colours and its presence is probably the cause of the variable results obtained on experimenting with aniline-oils of different makes.

Tungsten.—*(Wolfram.)*—A metal found accompanying tin which it somewhat resembles in its chemical properties. In combination with oxygen it forms tungstic acid, which combines with the alkalies, etc. The tungstate of baryta is a valuable white pigment, and unlike white lead is not affected by the fumes of sulphur. Tungstate of soda has been used as a substitute for and a mixture with stannate of soda with quite unsatisfactory results. With reducing agents it yields a fine blue colour which has not yet been successfully fixed upon fibre.

Turmeric.—The root of a plant (*Curcuma longa*), growing in India, China, and Madagascar, and now chiefly cultivated in Bengal. The roots are long and vary in thickness from that of a quill to about half an inch in diameter. They are wrinkled, and have joints or ring-like swellings at short intervals. Outwardly the colour is a yellowish-grey, whilst inwardly it is of a deep yellowish-brown, darkest in the middle.

When reduced to powder they appear of a bright yellow.

The roots contain from 5½ to 6 per cent. of mineral matter, moisture from 5 to 7, and 11 to 12 of colouring matter.

The colouring principle of turmeric is sparingly soluble in cold water, and dissolves freely in boiling. It is also soluble in alcohol.

By alkalies it is turned brown, whence paper saturated with tincture of turmeric has long been employed as a test. Sulphuric, nitric, and hydrochloric acids turn the colour of turmeric a kind of red, which, however, soon disappears; alkaline chlorides for a time brighten the colour, and solutions of iron turn it brown.

The only adulteration to which turmeric is liable in commerce is common salt, which is sometimes added in quantity to the roots whilst going through the mill. This sophistication, besides adding to the weight, gives it a brighter appearance in the powder, at the risk of very seriously interfering with its uses in the dye-house.

The detection of this fraud is easy. A small portion of the suspected powder is boiled in a test-tube, with pure concentrated nitric acid, till the organic matter is destroyed. The remaining liquid is then diluted with pure water, and a solution of nitrate of silver added. If salt has been present a copious white curdy precipitate will be formed.

The characteristics of a good turmeric are—it has a rich, deep, but bright orange colour, and a strong aromatic, rather pungent

odour. It should be perfectly dry. If damp it loses its brightness, turns a dull brown, and dyes only flat colours.

The best method of testing turmerics is to dye weighed pieces of woollen cloth with equal weights of the samples in boiling water. The swatches are compared for depth of colour and examined for brightness over-hand, *i.e.*, held up horizontally to the light, and viewed along the surface. In this position it should have a beautiful golden lustre, on the purity of which its value for many purposes mainly depends.

Turmeric is a so-called substantive colour, dyeing full shades without any mordant. It is, however, very fugitive, being affected by air and light, as well as by acids and alkalies. A very remarkable circumstance is that no mordant hitherto known increases its permanence, whilst nearly all bodies of that class decidedly impair its beauty.

Some time back the use of turmeric was almost exclusively confined to printing and dyeing silks. It is now employed to a vast extent in dyeing stuffs, forming an important constituent in certain compound colours applied to the cotton warps.

Oil of Turpentine.—(Otherwise called *Spirits of Turpentine* and *Turpentine.*)—This is the commonest and best known of the essential or volatile oils. It is obtained by distilling crude or raw turpentine, a semi-fluid resin. It should be clear and colourless; a drop placed upon paper and gently heated should leave no greasy mark behind, nor should any solid matter, resinous or otherwise, remain when a small quantity is evaporated to dryness. Oil of turpentine was formerly used to take out grease spots, but is now superseded by benzole. It is still employed by printers in mixing many colours, in order to prevent "flurrying" or frothing, and give uniformity of composition.

Tyrian Purple.—A splendid purple dye, of which descriptions are given by Pliny and other ancient authors. It was said to be obtained from two molluscs, which Pliny names *buccinum* and *purpura*. A small sac in the throat of each animal yielded a single drop of the precious liquid, but an inferior quality was obtained by crushing up the entire substance of the *buccinum*. At first it is colourless, but by exposure to air and light it becomes successively lemon yellow, green, sky-blue, red, and in about forty-eight hours, a splendid purple. The colour was remarkable

for its permanence. According to Plutarch, when Susa was taken by Alexander, a quantity of purple cloth was found in the treasury of Darius, which still retained its beauty, though 190 years old. The Tyrians gave the first ground for their purple dye, with the unprepared liquor of the *purpura*, and then heightened or topped it with that of the *buccinum*.

The *buccinum lapillus*, a shell-fish found in the British seas, yields a juice which undergoes a similar change of colour when exposed to air and light, and produces a purple dye on calico. In the time of Augustus a pound of wool dyed with the Tyrian purple was worth nearly £30, a sum which certainly gives scope for the use of rare and expensive material.

Ultramarine.—Natural ultramarine is, perhaps, the finest blue pigment known. The artificial, or imitation ultramarine, is now a common article of commerce, and is identical with the natural in composition, though decidedly less beautiful and very unstable, being at once destroyed by acids even in the state of vapour. However, from its low price, it is extensively used. It is insoluble in water, and cannot in any manner be dissolved without decomposition. Hence it can only be applied in pigment styles, by the aid of albumen or caseine.

It has also been used as a finishing blue, but, being insoluble, it cannot equal the aniline blues.

Uranium.—One of the rarer metals, which forms a variety of bright green, yellow, and orange-coloured compounds. It is employed to some extent in painting earthenware and staining glass, but has not yet been applied in dyeing or printing. It appears to have a strong affinity for vegetable fibre.

Uric Acid.—A peculiar substance, found naturally in the excrements of birds, reptiles, and insects, and usually prepared on a commercial scale from guano. It has not yet been obtained artificially.

When pure it is tastless and inodorous, forming brilliant white scales of a silky lustre. It is almost insoluble in cold water, sparingly soluble in boiling water. Dissolves more freely in concentrated sulphuric and in muriatic acids. It plays the part of a feeble acid in contact with the alkalies, forming salts, which are

nearly insoluble. It derives practical importance as being the source of MUREXIDE.

Urine.—Before the manufacture of ammonia had been developed, stale urine was much used by dyers in the preparation of wool, woollen cloth, etc., under the names lant, wash, or weeting. It contains a quantity of ammonia in the state of carbonate, and has, of course, alkaline and detergent properties. Some dyers maintain that, both for scouring and for modifying colours, lant is superior to the liquid ammonia made from gas liquor.

It is a remarkable fact that even urine is liable to adulteration being let down with water and weighted with refuse salt.

Its actual value may be ascertained by an alkalimetrical operation.

Urine substitutes are crystals of carbonate of soda in a fine state of division, so as to be readily soluble.

Valonia Nuts.—The cups of the acorns of *Quercus aegilops*, a species of oak which grows in Asia Minor, and is chiefly exported from Smyrna, as also from Trieste. They should be of a bright drab colour. If they are black, it is a sign that they have been allowed to become damp, and are in consequence impaired in in quality. The ordinary valonias are about two inches in diameter; but there is a smaller kind, not exceeding the size of a cherry, and known as *Camatas* and *Camatinas*. These are by some authorities described as being half-grown cups, whilst others pronounce them to be the produce of a distinct kind of tree.

The value of valonia nuts depends upon the tannin they contain, which enables them to be used for the same purposes as sumac, divi, etc.

They are rarely used in cotton dyeing, but answer better for silk.

Vanadium.—One of the rarer metals, found at Alderly Edge, near Manchester. Its salts form with astringents a blue-black colour, much more intense and permanent than that furnished by the salts of iron. Hence it is probable that, if a more plentiful supply were obtainable, it would become of importance in dyeing.

Verdigris.—*Acetate of Copper.*—There are several varieties of verdigris, differing both in shade and in mode of preparation.

That commonly employed in dyeing and printing is made by decomposing a solution of sugar of lead with an excess of blue vitriol. Its applications are now very limited, and where employed its utility is sometimes questionable.

Vermilion. — *Cinnabar.*—A compound of mercury and sulphur. The sulphuret of mercury as ordinarily obtained by precipitation, or by the immediate contact of its elements, is a dirty black; but when brought into the state of a crystalline powder it becomes a brilliant scarlet, almost as fine and more permanent than geranium red. Its great density and deficience in covering power render it not well adapted for a printing pigment. It is a strange fact that vermilion figures in some old receipts as an ingredient for scarlet dyeing. It cannot be dissolved without decomposition and the loss of its colour.

Vesuvine.—An aniline colour which has lately been introduced into commerce under this very absurd name. It yields various shades of deep orange and bright browns. It is a substantive colour upon silk and wool, but cannot be fixed upon cotton without mordants.

Viridic Acid.—*Viridinic Acid.*—A splendid green colouring matter which occurs in unroasted coffee, and is extracted by an expensive process. It may be fixed upon cotton by means of animal mordants, but possesses no distinctive advantages to counterbalance its high price. It is highly suitable as a green colour for confectioners.

Walnut Tree.—Almost every part of the walnut tree contains a principle which in contact with the atmosphere rapidly developes a deep brown colouring matter of great permanence. This is most abundant in the outer coat or husk of the nut, an extract of which is used in pomades for darkening the hair, and in stains for the complexion. It can also be employed for producing brown shades upon wool, and for "saddening" other colours in place of iron. The tinctorial principle of the walnut is clearly distinct from the astringents in as far as it is a substantive colour, and darkens *without* the presence of iron. Hence it deserves a more thorough chemical investigation than it has yet received. It is not, I believe, employed by English dyers.

Washing Paste.—A mixture of liquid caustic soda, with sufficient farina to form a paste. Some makers employed the white Devonshire clay as a thickener in place of, or along with the farina. It was a powerful but unsafe detergent, and is now rarely heard of.

Water.—Of all articles employed in dyeing and printing, water is the most important. If it be defective in quality or quantity, the greatest skill will be expended either in vain or at a great disadvantage. And to remedy bad water on "paying" terms is a most difficult, often an altogether impracticable affair. Pure water consists merely of oxygen and hydrogen combined in the proportions of 8 lbs. of the former to 1 lb. of the latter. But such water, like a mathematical line, exists merely in hypothesis. The purest water in existence holds in solution the gases and vapours of the atmosphere with which it has come in contact, as well as minute traces dissolved from the vessels in which it has been preserved. Almost all natural waters existing in available quantity contain foreign matter sufficient to modify to some extent their chemical behaviour, and to produce results different from what would be obtained even with ordinary distilled water, which is conventionally styled "pure."

The foreign matters present in water may be divided into two classes; substances merely held in suspension and such as are truly dissolved. The former are the less dangerous and the more easily removed. They consist of sand and clay, oxide of iron, sulphuret of iron, and debris of animal and vegetable substances; also in streams passing through manufacturing districts, greasy matter, compounds which may be styled soaps of lime, iron, alumina, lead, tin, etc. Some of these matters, especially spent or half-spent dye wares, grease, and the soaps just mentioned, are capable of doing much mischief. They are, however, capable of being removed by filtration whenever there is room for filter-beds and lodges sufficient to contain a necessary supply.

The dissolved impurities are more varied, more detrimental in their effects, and much more difficult to remove. They include gases held in solution, such as oxygen, hydrogen, nitrogen, carbonic acid, hydrosulphuric acid, etc.; liquid acids, such as sulphuric, muriatic, nitric, oxalic, free or combined; the alkalies, soda, potash, and ammonia; soluble salts of alumina, lime, magnesia, manganese, iron, copper, lead, tin, and arsenic; further extracts,

and solutions of dye-wares, the soluble portions of sewage, etc., etc.

The effects of these impurities are of course highly varied, nor can any stream contain *all* these in a liquid form, as many of them, on meeting, mutually precipitate each other. The most formidable are salts of iron and copper, which sadden all the dye-woods, cochineal, etc., and render it impossible to dye light and bright shades; salts of lime and magnesia, which prevent the water from bleeding the dye wares, and precipitate a portion of the dissolved colours as lakes, etc.; alkalies, which precipitate or spoil acid mordants, render it impossible to purify safflower, give scarlets and oranges an unpleasant bluish cast, etc. Soluble sulphides or hydro-sulphates blacken all colours containing lead, injure those containing tin, and spoil royal blues. The mixtures of organic matters, dye wares, etc., soil all fabrics, and lessen the lustre of every colour even when they do not positively alter the shade.

If it is intended to erect a new dye, print, or colour works, or to bring a fresh supply of water to one already existing, the proposed source, stream, or spring, should be carefully examined.

Note first the strata from which it is fed. The best waters are those which flow from clay-slate, granite, quartz-rock, trap-rocks, and mill-stone grit, or from beds of sand and gravel, also the surface-drainage of peat-moors. Those from dolomite, mountain limestone, chalk, etc., are inferior, being charged with lime and magnesia. In particular, the drainage from alum-shales, iron-shales, ochre-beds, and coal-deposits, which always contain iron-pyrites, should be avoided. To this end observe whether any of the feeders of the proposed stream deposit a yellowish-brown sediment (iron-mud) in their course; whether the stones lying in and near the water have yellow or brown discolourations, and whether there is an iridescent scum where the water is still.

In general, the water of rivers and lakes, if not artificially contaminated, will be better for tinctorial purposes than that of the springs by which they are fed, since certain salts, both of iron and lime, on prolonged exposure to the air, are rendered insoluble.

The next point is to ascertain what manufacturing refuse, sewage, etc., if any, enters the stream. Particular attention must be paid to possible sources of colouring matters, iron, acids, soap-refuse, grease, soda, tar-refuse, etc.

The next thing is to test the water. No one process is of course sufficient to detect all possible impurities. The water, if

turbid, is cleared by settling and filtration if necessary, and the following special tests applied. To detect alkaline sulphides, add a few drops of a solution of the nitro-prusside of potassium, which will give a fine violet tinge if this impurity be present. For salts of iron concentrate the water by evaporation in a white porcelain dish, noting if any ochreous matter is deposited. To the concentrated liquid add a solution of galls, and observe if any browning or blackening appear. To another portion a mixture of the red and yellow prussiates is added. A blue colouration or precipitate shows the presence of iron. Sulphuric acid is detected by adding first a few drops of pure nitric acid, and then solution of chloride of barium. A white precipitate shows the presence of sulphuric acid or soluble sulphates. If the water is in like manner acidulated with pure nitric acid, and a little of a solution of nitrate of silver added, a white curdy precipitate falls if muriatic acid or soluble chlorides are present. To detect lime, add to the concentrated water some oxalate of ammonia. If a white precipitate falls after standing a few minutes, lime is present. If alum or sulphate of alumina is present, sulphuric acid will be detected. Again, concentrate the water as far as practicable, add *pure* caustic soda in excess, and to the clear liquid decanted off from any precipitate add solution of sal-ammoniac. If this produces a gelatinous precipitate, alumina in a soluble state is present. To detect magnesia, a more complicated process is needed if alumina —as is possible—be also present: Evaporate to dryness, redissolve in pure nitric acid, and heat upon the sand-bath to 480° Fahr., keeping up the heat till a glass rod dipped in ammonia, and held over the vessel no longer shows the presence of acid fumes. This operation is best performed in a platinum capsule. The residue is moistened with a strong solution of nitrate of ammonia, and heated afresh till no more ammoniacal fumes are given off. The mass is treated with water, and digested at a gentle heat. A drop of weak liquid ammonia is added, which will occasion no turbidity if the heating has been rightly managed.

The clear is now decanted off, rendered slightly alkaline with ammonia, and mixed with oxalate of ammonia, allowed to stand several hours and filtered. This operation removes lime. Evaporate the clear filtrate to dryness with an excess of nitric acid to destroy ammoniacal salts; dissolve in pure water, and add phosphate of soda and a little ammonia. If a precipitate is formed, magnesia was present in the water.

Magnesia, if present as bicarbonate, is a very formidable impurity, being particularly unfavourable to madder-dyeing; if in the state of chloride or sulphate, it has very little detrimental influence. To ascertain this point, after having found that magnesia is present by the above process, take a fresh portion of the water and keep it at a boil for about an hour. Then allow it to cool, and filter it carefully. Then re-examine this clear liquid.

If magnesia is *not* found in this boiled and filtered water, or is found in smaller quantity than in the unboiled water, it exists, in part at least, as carbonate, which is held in solution by free carbonic acid. By boiling, the free carbonic acid is expelled, and the magnesia precipitated. Waters containing magnesia in this state may be corrected by the addition of a trace of oxalic acid.

Soluble organic matter is detected by adding a few drops of a solution of permanganate of potash. If organic matter is present this will soon be reduced, forming a brown precipitate of the hydrated peroxide of manganese.

The hardness of water depends on the amount of earthy matter present, whether lime, magnesia, iron, or alumina. This is best estimated by the "soap-test." This is performed as follows:—A solution of soap is made by mixing methylated spirit (free from shellac) with an equal measure of water, and adding a convenient quantity of soap—preferably the soft medicinal soap of the London Pharmacopœia—and letting the mixture stand in a stoppered flask or bottle at common temperatures till the soap is dissolved, and the liquid has grown clear. If at all turbid it may be filtered, and is then preserved in a stoppered bottle.

To find the value of this soap-solution, a standard water is needed. To prepare this, rub some pure crystallized gypsum (sulphate of lime) to a very fine powder; put 27·5 grains of this in an exact gallon of pure water, and let it dissolve. This quantity is equivalent to 16 grains of carbonate of lime, and hence the water was called by Clark, the inventor of the process, "standard water of 16° hardness," every grain of carbonate of lime, or its equivalent of other hardening matter, being called one degree of hardness.

When the standard water is ready, 1000 grain measures are put in a 6 oz. stoppered bottle and 40 grain measures are added of a cold saturated solution of carbonate of soda crystals. A pourette should have been filled with the soap solution, and this is

carefully dropped into the bottle until the point of saturation is reached. To ascertain this the bottle is from time to time stoppered and well shaken. As soon as a soft and abundant lather is formed which will remain for five minutes, the operation is at an end, and the number of degrees consumed is read off. It is most convenient, as saving calculation, if 32° of the soap-liquor have been used, in which case 2° of the pourette represent exactly 1 degree of hardness.

The value of the soap-liquid thus being known, it may be applied to testing waters.

1000 grain measures of the sample are placed in a bottle, mixed with 40 grain measures of the carbonate of soda solution and the soap-liquid added as above.

If the hardness of the water exceeds 16°, it is well to dilute it previously with an equal or double bulk of distilled water, then take 1000 grain measures of this diluted portion for examination, remembering to multiply the result obtained by 2 or by 3 according to the extent of dilution.

This method shows with great exactitude the value of a water for cleansing and scouring purposes, it being of course the better the less soap it needs to yield a lather. For dyeing and printing, and for extracting colours, it may also be laid down that a very hard water cannot be good, save for sad colours. But a very soft water if heavily charged with alkali may be wretched for tinctorial purposes, and two waters equally hard may be of very different values for dyeing according as the hardness proceeds from lime, magnesia, alumina, or from iron.

In all cases it is well after having ascertained the hardness of the water cold, as taken from the stream or spring, to boil another portion well, and test it again. If a difference is found, as is generally the case, that difference is caused by lime or magnesia present in the form of bicarbonate, and rendered insoluble by boiling. The hardness remaining *after* boiling is due to sulphates and chlorides of lime, magnesia, etc., and is noted as permanent hardness.

By this double procedure we ascertain not merely the amount of the hardening matter but to some extent, its nature, and how it may be removed.

To supplement the soap-test the following procedure may be employed, and will be found very useful in ascertaining the comparative value of waters for tinctorial purposes. Make a standard

extract of logwood by digesting distilled water upon an excess of rasped logwood in a stoppered flask for 24 hours. Pour off the clear and preserve it in a stoppered bottle. If it is needful to examine a number of samples of water, provide a set of clear white glass phials holding a little more than 4 ozs. Put into one phial 4 ozs. of distilled water and add 100 gr. measures of the logwood liquor. Place 4 ozs. of each sample in one of the other bottles, and add 100 grs. of logwood liquor to each, and compare the colours. The phial with distilled water will be of a clear reddish amber colour. The others will depart from this standard according to the nature and amount of their impurities. If the water contain a soluble chloride it will be yellower than with pure water. Sulphate of lime and alkaline sulphates give a yellowish olive colour. Alkalies, caustic or carbonated, give a brownish red; salts of alumina, a maroon passing into plum-colour; free acids a cherry; and salts of iron and chromates a brownish black. Even the quantities of these various impurities may be approximatively estimated by preparing solutions containing known quantities of the salts in question and comparing their action, at various stages of dilution, upon the logwood liquor, with that of the water under examination.

Purification.—The purification of water on a practical scale is in some cases exceedingly difficult and in all expensive, owing to the amount of room required. The available expedients are three, subsidence, filtration, and liming. The action of the two former is very nearly connected. Subsidence is merely a carrying out of a fact observed in nature, and to which we have already alluded, that rivers are usually found freer from mineral impurities than the springs whence they are fed. This is readily explained, the action of exposure to the air, especially in shallow extended layers, is similar to that of boiling. Bicarbonates are decomposed and free carbonic acid escapes whilst the neutral carbonates of lime, magnesia, and iron, subside in an insoluble state. Again, all soluble protosalts of iron are decomposed, the bulk of the objectionable metal remaining behind in the form of insoluble subsalts. All matters also, mineral or organic, held merely in suspension, are removed.

The best arrangement for subsidence, and at the same time the first step to filtration, is a reservoir, having its greatest length in the direction of the current. It should not be very deep, but as extensive as the ground and the owner's means will

admit. At the top end it must be provided with a sluice, so that the water of the stream can be admitted only when desirable. If there are any works above which emit refuse, it is well to admit water to the reservoir only in the night and on Sundays.

Filtration.—Filtration consists, in principle, in passing water through porous matter, which shall by mechanical action arrest all insoluble suspended matter, and shall also exert a chemical action by means of the oxygen condensed in its pores. The bed of a filter should commence with coarse large irregular stones, over which is laid rough gravel, and finally a bed of fine sand about a foot in thickness. All these materials must be such as can neither furnish iron, alumina, lime, or magnesia to the water. An excellent material to place above the gravel is the surface soil of moorlands, consisting of a mixture of peat and clean sharp siliceous sand. This article is abundant and cheap in the manufacturing districts of Lancashire, Yorkshire, and Scotland, and is, to the best of my knowledge, the most efficacious substance available. The size of each filter must depend upon the quantity of water required, but it should never be allowed to stand deep over the filter-bed, otherwise the effect of the porous materials in transferring oxygen from the air to the impurities in the water will be lost. Therefore the water, as it flows from the subsidence-reservoir, must be allowed to enter at just such a speed that it may keep the whole surface evenly wet, and be drawn off below as fast as it filters through.

Of course a filter, however well made, will in course of time cease to act, being choked up with the dirt deposited by the water in passing through. It is well, therefore, to provide a double series of filters, the one to be in action whilst the other is cleansed and relaid. The cleansing is generally effected by scraping off a few inches of the sand, and placing it where it may be exposed to to air, sun, and rain for some weeks before it is put back. Where suitable filtering material is near at hand, the filter-bed is better made up with new sand, etc. How often the filter requires renovating depends upon the quality of the water and the amount of work performed. The only rule that can be laid down is to attend to the matter as soon as a filter either passes its water too slowly, or without being sufficiently purified. Great care should be taken in the mode of leading the water into a filter. If allowed to enter with great force, and to impinge upon one particular spot, it may

make one or two channels through the bed, and thus escape without filtration.

Liming.—In many cases the addition of milk of lime will be beneficial to waters charged with either mineral or organic impurities. The bicarbonates are precipitated by this expedient, iron is got rid of, and a great many organic matters are deposited in the form of lakes. This operation, when required, is best performed in the stream above the subsidence-dam. The addition should be gradual and constant, so that all the water in the channel may be acted upon.

Other additions have been recommended, and used in particular cases. Thus, to remove mineral matters and render water softer, beds have been constructed of spent madder and other dye wares, and over these the water has been filtered. I think the peat or moor-earth recommended above will be found more convenient and efficacious. With certain waters acids may be required to neutralize an alkali, or alkalies to "kill" an acid. Such additions, where needed, are best made in the dye-pan or cistern.

Purification of Spent Waters.—Sometimes the dyer or printer is required not alone to purify the water which he receives so as to render it fit for use, but to filter the waste liquors which he discharges, in order to escape litigation, on the score of nuisance. The increasing attention paid to the pollution of rivers will probably compel greater and more general care in this respect.

Having had successful experience in dealing with the refuse of dye-works, I can say that, where a plot of falling ground can be had below any works, the water can be emitted in a state perfectly free from nuisance. If the refuse of a dye-works were allowed to flow continuously into a river as every vat or beck becomes spent, a great nuisance would be created. But if these various kinds of refuse are allowed to pass into a settling-dam large enough to hold two or three days' store, the case is entirely altered. The various wares, etc., present, react upon each other, and the impurities are thrown down in an insoluble form. The articles likely to be in excess are the spent or nearly spent dye-woods—logwood, peachwood, etc.—which are sure to arrest any iron, chrome, tin, copper, etc., emitted from the dye-works. The faint tinge of colour resulting from these woods is afterwards easily got rid of by passage through a filter-bed, with the addition of a little lime.

This simple system was successfully carried out at Jackroyd

Dye-works, Wheatley, near Halifax, where litigation had arisen in consequence of the emission of refuse into the river Hebble. To meet the difficulty, the spent liquors from the works were collected in a settling-dam divided into several compartments. When the first compartment was full the foul water passed through wire-gauze at the surface into the second, and when this also was filled, into a third. In these dams the various ingredients had opportunity to react upon each other, to undergo the influence of the atmosphere, and to deposit their insoluble ingredients. From the last settling-dam the water was allowed to enter filter-beds, and on issuing from them it reached a couple of dams near the river. In these it was clear, colourless, and devoid of smell and taste. Attested samples of the water were found by the soap-test softer than the spring supplying the works. When submitted to careful chemical examination the same water was found equal to the water of the Hebble above the dye-works, and superior to the water with which at another works in the district the most delicate cochineal, safflower, and aniline shades were being successfully dyed. Finally, a most important point, the firm occupying the works, being short of water from the dryness of the season, conveyed the water back from the last dam and used it with satisfactory results.

Weld, or Wold.—A yellow colouring matter which has latterly fallen into nearly complete disuse. The whole plant is used, though the colouring matter is found chiefly in the tops. It is met with in commerce dried in the form of sheaves or bundles. For use it is placed in bags suspended in the dye-beck, or else previously extracted with water and the decoction applied to the goods. The decoction in water is yellow, with a slight greenish cast. The colour is deepened and rendered turbid by acids, changed to a more golden hue by alkalies, thrown down as a yellow lake by the salts of alumina, tin, and lead.

It is used mostly for silk, less frequently for cotton, upon both of which fibres it gives a fine bright yellow with alum, and a still superior shade with the aluminate of soda. These shades bear washing with soap and water, but are sooner or later impoverished by exposure to air. The pure colouring matter of weld is known as *luteoline*, from the botanical name of the plant, *Reseda luteola*.

Woad.—*Isatis sativa*, a plant containing a small amount of

indigo, and formerly used as a dye, though now merely added to indigo-vats for wool-dyeing as a promoter of fermentation. A variety of the plant cultivated in the south of France is known under the name of Pastel, whence the term pastel-vat applied especially by foreign dyers to a kind of indigo-vat.

Wongshy.—The seed capsules of a Javanese plant of the order Gentianeæ, used, or capable of being used, as a yellow die.

The colouring principle is soluble in water, with a fiery red colour, which, when diluted largely passes into a golden yellow. The tinctorial power appears high. It dissolves also in alcohol with similar colours. The solution in water is not precipitated by acids; by alkalies only when added in excess; unaffected by proto-chloride of tin in the cold, but on boiling a deep orange-lake is produced. Alum and red-liquor give yellow precipitates only on boiling. Lime and baryta water give yellow precipitates in the cold. Neutral acetate of lead gives no precipitate, and basic acetate an orange precipitate on boiling.

It dyes wool a fine orange shade without any mordant, the addition of which rather impairs the result. The best shades are obtained at about 104° Fahr. At the boiling point the colour produced is less pure.

Upon silk it proves also to be a substantive colour, giving a bright gold shade.

For cotton a mordant—preferably a salt of tin—is needed, when the shade produced is orange.

These colours are very fugitive upon cotton, faster upon wool, and best upon silk, where they rank with the best yellows known, as regards resistance to the action of light. They are not affected by soap-scouring upon any fibre.

Fine shades of yellow may be obtained by adding small quantities of potash, soda, or ammonia, caustic or carbonated, to the watery extract of wongshy before immersing the cloth in the dye.

Wongshy resembles annatto in many respects, but differs in being turned yellower by alkalies, and redder by acids and the salts of tin.

Wood Tar.—A solution of wood tar in ten times its weight of water; in other words, tar-water, allowed to settle and filtered, has been recommended as giving a fine ash-grey with a mordant of per-chloride of iron. The colour produced is more of a drab

than an ash, and, though good of its kind, has nothing sufficiently distinctive to warrant its adoption.

Wool.—A few of the chemical properties of wool require brief notice. Wool is readily injured, and even destroyed and dissolved, by the caustic alkalies, potash and soap, and certain of their compounds. Hence, as a general rule, it is ill-adapted for alkaline mordants, such as the aluminates, stannates, plumbates, etc. These compounds not only fail to deposit their alumina, tin, etc., in sufficient quantity and with due regularity, but frequently injure the fibre itself.

On the other hand, wool can bear the action of strong acids and acid salts much better and longer than cotton. Aqua-fortis, however, if allowed to act upon wool in a concentrated state, turns it indelibly yellowish or brownish, the surface of the wool being converted into picric acid. Free chlorine and bleaching powder likewise give wool a permanent yellowish tint.

The sulphur naturally present in wool is an important feature. Some contend that this constituent is the cause of the superior affinity of wool for colours, which others again ascribe to the nitrogen. Attempts have been made to combine sulphur with vegetable fibre for the purpose of increasing its affinity for colours, but the results have been unfavourable. The presence of sulphur is one cause of the unfitness of wool for alkaline mordants. These appear to extract the sulphur from the wool, forming a portion of alkaline sulphide, which, reacting upon the lead or tin present, blackens it.

The superiority of wool to cotton, as regards its affinity for organic colours, is striking. It takes many colours which vegetable fibre will not take at all, and many more, though they can be fastened upon cotton, are much more beautiful and permanent upon wool.

Xylidine Red.—A new colour prepared from a mixture of xylidine and aniline, heated with arsenic acid, as in the preparation of magenta. It forms carmine-red masses, and dyes wool and silk a beautiful colour.

Yellow Colours, Detection of.—*Chrome Yellows.*—Blackened by sulphuretted hydrogen; destroyed by caustic alkalies (on cotton).

Annatto.—Little affected by chlorine or bleaching powder; a bluish-green with oil of vitriol. Discharged by nitric acid.

Fustic and *Young Fustic* are also not much affected by bleaching powder; with oil of vitrol they are reddened, and with nitric acid discharged. A deep brown, with caustic soda.

Quercitron Bark and Flavine discharged by chlorine and sulphurous acid, not perceptibly browned by soda or tin-salt.

Persian Berries.—Discharged by chlorine; turned an orange-brown by tin-salt; give a stone colour with sulphuric acid.

Turmeric, browned and dissolved out by dilute acids and alkalies.

Picric Acid (silk and wool only).—The tissue has a bitter taste. Unaffected by acids. Dissolved off by alkalies.

Zinc.—A metal which has some resemblance to tin in its appearance, but little in its chemical and tinctorial relations. It is much more readily soluble in acids than tin, forming solutions of a much higher specific gravity, which are less readily rendered turbid or precipitated by exposure to the air or by admixture of water, cold or hot. It does not form an insoluble compound with nitric acid. It forms only one oxide and one chloride. Its salts combine with colouring matters to form lakes. These, however, have for the most part a dull, earthy appearance, and are held together by a very feeble affinity. For animal and vegetable fibre, the compounds of zinc have scarcely any affinity, and are hence useless as mordants. The only compounds of zinc which have been at all employed in the tinctorial arts are the oxide, hydrate, chloride, nitrate, sulphate, and acetate.

Zinc, Acetate.—A soluble salt generally obtained by mixing the sulphate of zinc with sugar of lead, both in solution, and decanting the clear liquor. It is rarely used except as a mordant for murexide yellows.

Zinc, Chloride of, known also as *Muriate of Zinc* or *Butter of Zinc.*—This salt is a colourless liquid, or if concentrated a syrup. It can easily be brought to a state of perfect neutrality, and is then rendered slightly turbid if mixed with water. It combines readily with most colouring matters, effecting little change in their properties, and abandoning them to any salt of tin, iron, or alumina, with which it is brought in contact.

Chloride of zinc is an antagonist to fermentation, putrefaction, and the development of those low forms of vegetable life known as mildew, mouldiness, etc. It is also strongly deliquescent, attracting moisture from the air. Hence it is sometimes added to colours and other mixtures to prevent drying up. By printers it is sometimes used to fix the alumina of alkaline pink mordant.

Zinc, Nitrate.—A very deliquescent salt, sometimes used to keep colours moist. Its properties and applications are very similar to those of the chloride of zinc, but being more costly it is less used.

Sulphate of Zinc, otherwise known as *White Vitriol.* It is a white, semi-transparent, crystalline body, easily soluble, and having the property of coagulating animal fluids and preventing fermentation and putrefaction. Its uses are but limited. It has been proposed as a substitute for tartaric acid as a discharge, and in some styles it serves as a resist. In dyeing it can scarcely be said to have any application at all, though some practical men assert that if used along with tin mordants it throws the tin better upon the fibre. My own observations lead me to the opinion that where not inert it is rather injurious.

Sulphate of zinc is sometimes fraudulently used as an adulterant in tin-crystals, double muriate, and other preparations of tin.

THE END.

INDEX.

	PAGE
Acetate of alumina	150
,, copper	195
,, iron	1
,, lead	98
,, rosaniline	110
,, soda	165
,, tin	189
Acetic acid	2
Acid, acetic	2
,, aloetic	12
,, arsenic	26
,, arsenious	26
,, benzoic	30
,, carbazotic	142
,, carbolic	40
,, carbonic	41
,, carminic	47
,, catechuic	43
,, chrysammic	45
,, citric	46
,, erythric	66
,, erythric (Brugnatelli's) ...	11
,, gallic	75
,, hydrochloric	83
,, isopurpuric...	94
,, japonic	43
,, lactic	97
,, lecanoric	100
,, malic	113
,, manganic	114
,, muriatic	5, 83
,, nitric	126
,, nitro frangulic	71
,, nitrous	126
,, oxalic	138
,, phenic	40
,, phosphoric...	142
,, picramic	142
,, picric	142
,, purpuric	148
,, pyroligneous	2
,, rosolic	152
,, rubinic	43
,, sulphindigotic	92

	PAGE
Acid, sulphindylic	92
,, sulphuric	178
,, sulphurous...	5, 181
,, tannic	183
,, tartaric	185
,, uric...	194
,, viridic	196
Acidimetry	3
Acids	3
Agar-agar...	4
Ageing liquor	4
Air...	4
Albumen	6
Alcohol	6
Alcohol, methylic...	125
Aldehyde	7
Aldehyde green	19
Alder bark	7
Algaroba	7
Alizarine	8
Alizarine, artificial	8
Alkalies	30
Alkalimetry	8
Alkaline, pink mordant	165
Alkaloids	10
Alkanet	11
Alloxan	11
Alloxantine	11
Aloes	12
Aloetic acid	12
Alum	12
,, ammonia	13
,, basic	13
,, cake	14
,, patent	14
,, roach	12
,, rock	12
,, Roman	12
Alumina, acetate	150
,, nitrate...	13
,, muriate	13
,, sulphate	14
Aluminate of potash	166
,, soda	165

	PAGE
Aluminium, chloride	13
Ammonia	14
Ammonia-alum	13
Aniline	16
Aniline, black	17
,, blue	17
,, brown	18
,, crimson	20
Aniline, heavy	17
Aniline-greens	18
Aniline-greys	18
Aniline, light	16
Aniline-oil	16
Aniline-red	20
,, violets	20
Anchusine	11
Annatto	21
Antichlore	169
Antimony	22
Aqua-fortis, double	126
,, single	126
Aqua-regia	22
Archil-liquor	23
Archil-paste	23
Areometer. (See Hydrometer.)	
Argentine effects	24
Argol, red	24
,, white	24
Arseniates	26
Arsenic	26
Arsenic acid	26
Arsenious acid	26
Arsenites	27
Artichoke-green	27
Astringents	27
Aurine	27
Azale	27
Azaleine	110
Azuline	28
Azurine	28
Baraniline	17
Barberry root	28
Barilla	28
Bark, alder	7
,, extract of	29
,, hemlock	83
,, Panama	140
,, quercitron	149
,, soap	140
Barwood	28
,, spirits	29
Baryta, carbonate	30
,, sulphate	30
Bases	30
Beaume's hydrometer	86
Beck's hydrometer	87
Benzine	30
Benzoic acid	30
Benzole	30
Biborate soda	36
Bichloride tin	189
Bichromate potash	144
Bichrome	144
Bismark brown	18
Bismuth	31
Bixine	21
Black, aniline	17
,, ash	32
,, Lightfoot's	17
,, Lucas	17
,, Mordant	1, 32
,, Petersen's	17
Blacks, detection of	32
Bleaching-lime	32
,, liquors, testing of	34
,, magnesia	113, 33
,, powders	32
,, soda	33
Blood-mordants	121
Blue, aniline	17
,, distilled	34
,, Lyons	17
,, opal	137
,, Paris	34
,, Prussian	147
,, regina	17
,, Saxony	31
Blues, detection of	35
,, finishing	67
Bone-size	159
Borax	36
,, powder, French	36
Brazil-wood	36
Brazilein	37
Brazilin	37
Brauna-wood	36
British Gum	62
Bromine	37
Bronzes	38
Broom	38
Buck-wheat	38
Burling-inks	38
Burling-iron	39
Cactin	132
Calcined copperas	59
Camatas	195
Camatinas	195
Camwood	39
Caoutchouc	39
Carajurn	40
Carbazotic acid	142
Carbolic acid	40
Carbon, bisulphide	31
Carbonate of soda crystals	168
Carbonic acid	41
Carmine	41
Carminic acid	47
Carragheen moss	123

	PAGE
Carthamine	41
Cartier's hydrometer	88
Caseine	41
Catechu	42
Catechuic acid	43
Chayaver	44
Chemic	44
Chestnut	44
Chica	40
China clay	47
Chinese green	44
Chinoline blue	44
Chlorophyll	45
Chromate lead	98
,, potash	145
,, soda	168
Chrome, red	144
,, yellow	145
Chrysammic acid	45
Chrysaniline	45
Chrysaniline red	45
Cinnabar	196
Citric acid	46
Clay, China	47
,, Cornish	47
,, Devonshire	47
Cochineal	48
Cocoa-nut oil	135
Colloids	49
Colorine	50
Colours	50
,, examination of	54
,, of animals	55
,, of flowers	68
,, of fruits	71
Copper, acetate	195
,, ammoniuret	56
,, nitrate	56
,, sulphate	57
Copperas	58
,, calcined	59
Coralline	59
Cork	59
Cotton	60
Crimson paste	60
Crimson spirits	173
Crocine	77
Crystallization	60
Cuba wood	72
Cubic nitre	169
Cubic petre	169
Cudbear	61
Cutch	42
Cyanol	16
Cyanide potassium	147
Cyanine	70
Datiscetine	61
Datiscine	61
Deliquescence	61
Devonshire clay	47
Dextrine	62
Dialysis	62
Diffusion	62
Divi-divi	63
Double aqua-fortis	126
Double muriate	122
Double oil of vitriol	178
Dung-substitutes	26
Efflorescence	66
Emeraldine	66
Endosmose	66
Epsom salts	113
Erythric acid	11, 66
Erythrose	66
Escholzine	67
Extract of bark	29
,, fustic	73
,, indigo	91
,, logwood	106
,, peachwood	37
Extracting liquor, Runge's ...	67
Farina	175
Fecula	175
Fibres, separation of	68
Finishing blues	67
Finish	6
Flavine	68
Fleur de garance	109
Flowers, colours of	68
Franguline	70
French purple	89
Fruits, colours of	71
Fuschine	71
Fustet	73
Fustic	72
Fustic, young	73
Galium	73
Gall-nuts	74
Galls, wild	74
Gallic acid	75
Gallipoli oil	135
Gambier	42
Garanceux	75
Garancine	75
Gardenia pods	76
Gelatine	77
Geranium red	78
Glaubers salts	177
Glucose	177
Glue	77
Glue-size	159
Gluten	121
Glycerine	78
Grape sugar	177
Grey, aniline	18
Green aniline	18

	PAGE
Green artichoke	27
Green, Chinese	44
Green, grass	45
Green, mordant	169
Green, Verdeil's	27
Greens, detection of	78
Gum Arabic	79
,, British	62
,, cherry	80
,, mezgnite	80
,, Senegal	80
,, substitutes	62
,, tragacanth	81
,, yellow Australian	81
Gutta percha	82
Gypsum	82
Hæmatoxylin	103
Harmaline	183
Hemlock bark	83
Hollyhock...	83
Hydrate of lime	102
,, soda	167
Hydrochloric acid	83
Hydrometer	85
Hypochlorite, lime	32
,, magnesia	33
,, soda	33
Hyposulphite, soda	169
Iceland moss	123
Imperial purple	89
India-rubber	39
Indian yellow	149
Indigo	89
Indigo-carmine	92
,, extract of	91
,, extract, red	93
,, refined	93
,, soluble	91
,, sulphate	92
Ink, burling	38
Iodine	94
Iron, acetate	1
,, burling	39
,, chloride	94
,, liquor	1
,, muriate	94
,, nitrate	128
,, persulphate...	94
,, pyrolignite	1
,, sulphate	58
,, sulphuret	94
Isopurpuric acid	94
Japonic acid	43
Jute	95
Kelp	95
Kino	95
Lac dye	95
Lac lake	95
Lactarine	97
Lactic acid	97
Lake colours	97
Lamp black	97
Lao-kao	44
Lard	135
Lead, acetate	98
,, chromates of	98
,, nitrate	132
,, peroxide	98
,, red	98
,, subacetate	99
,, sugar of	98
,, sulphate of...	99
,, white	99
Lecanoric acid	100
Leucogene	167
Leukalinine	100
Lichens	100
Light	100
Lignine	101
Lima-wood	102
Lime, bleaching	32
,, carbonate	102
,, caustic	102
,, chloride	32
,, hypochlorite	32
,, quick	102
,, sulphate	82
Lime-juice	46
Linseed	102
Linseed oil	136
Liquor, bark	29
,, black	1
,, fustic	73
,, logwood	106
,, peachwood	37
,, red	150
Lithospermine	102
Logwood	103
Madder	107
Madder flowers	109
Madder orange	109
Mafurra oil	110
Magdala red	110
Magenta	110
Magnesia, bleaching	33
,, carbonate	112
,, hypochlorite	33
,, sulphate	113
Magnesium, chloride	113
Malic acid...	113
Manchester yellow	113
Manganese	114
Mango (see Bleaching Lime) ...	114
Mangrove bark	114
Mauveine	114

	PAGE
Measures and weights, French system	115
Mercury, chloride	117
,, iodide	78
Methylated spirit	6
Methylic alcohol	125
Molybdenum	118
Monarda	118
Mordants	118
,, animal	121
,, organic	121
Mordant, black	1, 32
,, blood	121
,, green	169
Moreine	72
Morindine	172
Morine	72
Moss, Carragheen	123
,, Iceland	123
,, Irish	123
Munjeet	122
Murexide	123
Muriate, alumina	13
,, double	122
,, iron	94
,, single	122
Muriatic acid	83
Myrobalans	123
Naphtha, wood	125
Naphthaline	125
Naphthaline red	110
Naphthylamine yellow	113
Nitric acid	126
Nitrate alumina	13
,, copper	56
,, iron	128
,, lead	132
,, rosaniline	110
,, soda	169
Nitrite soda	169
Nitrogen	4
Nitrous acid	126
Nona	132
Nopal	132
Nux vomica	133
Oils and Fats	133
Oil, cocoa-nut	135
,, Gallipoli	135
,, linseed	136
,, Mafurra	110
,, olive	135
,, palm	135
,, pine	136
,, rape	135
,, rosin	136
,, tallow	136
,, vegetable	136
Oil, vitrol	178
Oleine	136
Olive oil	135
Opal blue	137
Orange madder	109
,, Victoria	45
Orchella weeds	137
Orchill	23
Orceine	138
Orpiment	138
Oxalate of tin	138
Oxalic acid	138
Oxygen	139
Ozone	140
Palm oil	135
Panama bark	140
Paris blue	34
Paris, plaster	82
Paulownia	141
Peachwood	141
Pearl ashes	146
Peganon harmala	183
Peonine	59
Persian berries	141
Phenic acid	40
Phenicienne	142
Phenyle, hydrate of	40
Phosphoric acid	142
Picramic acid	142
Picric acid	142
Pigments	54
Pine oil	136
Pink salt	143
Pipe clay	47
Pittacal	143
Plum spirits	173
Plumbate soda	170
Polychroite	154
Pomegranate husks	143
Potash, aluminate	166
,, bichromate	144
,, chlorate	145
,, chromate	145
,, prussiate red	148
,, ,, yellow	145
Potashes	146
Potassium cyanide	147
,, ferridcyanide	148
,, ferrocyanide	145
Potato leaves	147
Preparing salt	176
Prussian blue	147
Prussiate, red	148
,, yellow	145
Pseudo-toluidine	191
Purple, French	89
,, Imperial	89
,, Regina	152

	PAGE
Purple, Roman	123
,, Tyrian	193
Purpuric acid	148
Purpurine	109
Purree	149
Pyroxiline	149
Quercitron bark	149
Rape oil	135
Red colours, detection of	150
Red, aniline	20
,, argol	24
,, chrome	144
,, chrysaniline	45
,, cotton spirits	174
,, extract indigo	93
,, geranium	78
,, kino	95
,, lead	98
,, liquor	150
,, Magdala	110
,, naphthaline	110
,, Prussiate	148
,, rhubarb	66
,, sorghum	173
Red woods	151
Red, xylidine	207
Regina blue	17
,, purple	152
Rhamnoxanthine	70
Rhubarb, red	66
Rhubarb leaves	152
Roman purple	123
Roseine	110
Rosin	152
Rosin oil	136
Rosaniline	152
,, acetate of	110
,, hydrochlorate of	71
,, muriate	71
,, nitrate	110
Rosolic acid	152
Ruby	20
Rue, Syrian	183
Safflower	152
Saffron	154
Sal-ammoniac	155
Sal-enixum	177
Salt, common	155
Salt, Epsom	113
Salt, Glaubers	177
Salts, spirits of	83
Samples, taking	155
Sanders wood	156
Santal wood	156
Santaline	156
Sapan wood	157
Saxony blue	91
Scarlet spirits	157
Silicates, alkaline	157
Silk	158
Size, bone	159
,, glue	159
Soap	160
Soap-bark	140
Soap-powders	164
Soaps, dry	165
Soda, acetate	165
,, aluminate	165
Soda-ash	166
,, biborate	36
,, bicarbonate	167
,, bisulphite	167
,, bleaching	33
,, carbonate	168
,, caustic	167
,, chromates	168
,, crystals	168
,, hypochlorite	33
,, hyposulphite	169
,, nitrate	169
,, nitrite	169
,, plumbate	170
,, plumbite	170
,, Scotch	168
,, silicate	157
,, stannate	170
,, stannite	172
,, sulphate	177
Solution of tin	172
Sooranjee	172
Sorghum red	173
Spirits, barwood	29
,, bowl	157
,, cotton, red	174
,, crimson	173
,, plum	173
,, protartar	185
,, purple	173
,, royal blue	174
,, ,, finishing	174
,, salts	83
,, scarlet	157
,, ,, finishing	138
,, yellow	174
Starches	175
Sublimate, corrosive	117
Sugar	176
Sulphate alumina	14
,, copper	57
,, indigo	92
,, iron	58
,, lead	99
,, lime	82
,, soda	177
Sulphuret of iron	94
Sulphuric acid	178
Sulphurous acid	181

	PAGE
Sumac	181
Super argol	183
Syrian rue	183
Tannic acid	183
Tannin	183
Tallow	135
Tallow-oil	136
Tartar	184
Tartar cake	185
,, cream of	184
,, essence	185
,, liquid	185
Tartaric acid	185
Thermometer scales	186
Tin	186
Tin, acetate	189
,, bichloride	189
,, chloride	122
,, crystals of	190
,, muriate, double	122
,, ,, single	122
,, nitrate	157
,, nitro-muriate	191
,, oxalate	138
,, oxymuriate	191
,, perchloride	191
,, permuriate	191
,, preparing	170
,, salts of	190
,, solution of	172
Toluidine	191
Tungsten	192
Turmeric	192
Turpentine, oil of	193
Twaddle	85
Tyrian purple	193
Ultramarine	194
Uranium	194
Uric acid	194
Urine	195
Urine substitutes	195
Valonia nuts	195
Vanadium	195
Vegetable oil	136
Verdeil's green	27
Verdigris	195
Vermillion	196
Vesuvine	196
Victoria orange	45
Vinegar, wood	2
Violets, aniline	20
Viridic acid	196
Viridine	19
Vitriol, blue	57
,, green	58
,, oil of	178
,, Roman	57
,, white	209
Walnut	196
Washing pastes	197, 164
,, powders	164
Water	197
Weighting liquor	113
Weights, French system of ...	116
Weld	205
White lead	99
Woad	205
Wongshy	206
Wood-spirit	125
Wood-tar	206
Wood-vinegar	2
Woody fibre	101
Wool	207
Xanthine	70
Xantho-purpurine	190
Xanthophyll	45
Xanthorhamnine	142
Xylidine, red	207
Yellow chrome	145
Yellow gum, Australian	81
,, Indian	149
,, Manchester ...	113
,, naphthylamine ...	113
,, Prussiate	145
,, spirits	174
Yellows, detection of	207
Young fustic	73
Zante fustic	73
Zinc	208
,, acetate	208
,, chloride	208
,, muriate	208
,, nitrate	209
,, sulphate	209
,, vitriol	209

F. BENTLEY AND CO., PRINTERS, SHOE LANE, LONDON.